A QUALITATIVE STUDY DESCRIBING THE RELATIONSHIP
AND MEDIATING FACTORS BETWEEN JUNIOR HIGH
SCHOOL MATHEMATICS ACHIEVEMENT AND
COMPUTER EXPENDITURES

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

Doctor of Philosophy

By

Marlene Lovelace Carle, M.A.
Denton, Texas
December, 1985
Carle, Marlene Lovelace, *A Qualitative Study Describing the Relationship and Mediating Factors Between Junior High School Mathematics Achievement and Computer Expenditures.*

Doctor of Philosophy, (Administrative Leadership), December, 1985, 253 pp., bibliography, 40 titles.

Using a case study approach, this investigation focused on the nature of the relationship between computer related expenditures and student achievement in mathematics, with consideration given to the mediating factors influencing the relationship. Some of these factors included the types of computers and software being used, the objectives of computer instruction, teacher preparation in the use of the computer as an instructional tool, the amount of time individual students had access to a computer during the school year, and the socioeconomic status of pupils.

Two of the twenty-five largest school districts in Texas were selected as the subjects for this study. Numerical data were collected from existing documents including general ledgers, bid tabulations, test score tables, and records showing the numbers of students participating in the free and reduced price lunch programs. Specific information regarding the implementations of the instructional programs was gathered through observations and
interviews with principals, teachers, and students in fourteen junior high schools in each of the two school districts. The districts exhibited more differences than similarities in the approaches to using computers for instruction in mathematics. One district, for about two hundred dollars per student, purchased a prepared, copyrighted, and patented program consisting of mini-computers and sixteen terminal remote labs used exclusively for the remediation of students two or more years behind in achievement in mathematics. The other district purchased microcomputers at a cost of about ten dollars per student and introduced a three to six weeks unit on computer programming into the eighth grade mathematics curriculum.

Although neither district demonstrated clear patterns of increased achievement, tendencies did emerge which would suggest some linkage between concentration of the program and achievement. Other factors emerging from the forty-three taped interviews indicated that achievement test scores of students should not be the only measure of the worth of the computer-assisted instructional programs used in these school districts.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>vi</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>vll</td>
</tr>
<tr>
<td><strong>Chapter</strong></td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Problem</td>
<td></td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td></td>
</tr>
<tr>
<td>Research Questions</td>
<td></td>
</tr>
<tr>
<td>Background and Significance of the Study</td>
<td></td>
</tr>
<tr>
<td>Methodology</td>
<td></td>
</tr>
<tr>
<td>Assumptions</td>
<td></td>
</tr>
<tr>
<td>Limitations</td>
<td></td>
</tr>
<tr>
<td>Definitions</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
</tr>
<tr>
<td>Procedures for Data Collection</td>
<td></td>
</tr>
<tr>
<td>Data Analyses</td>
<td></td>
</tr>
<tr>
<td>II. REVIEW OF RELATED LITERATURE</td>
<td>22</td>
</tr>
<tr>
<td>Expenditures and Achievement</td>
<td></td>
</tr>
<tr>
<td>Computer Curricula and Achievement</td>
<td></td>
</tr>
<tr>
<td>Importance of Further Study</td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td></td>
</tr>
<tr>
<td>III. RESEARCH METHODOLOGY</td>
<td>50</td>
</tr>
<tr>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>Methodology</td>
<td></td>
</tr>
<tr>
<td>Procedures</td>
<td></td>
</tr>
<tr>
<td>Subjects</td>
<td></td>
</tr>
<tr>
<td>Data Collection</td>
<td></td>
</tr>
<tr>
<td>Data Analysis</td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td></td>
</tr>
</tbody>
</table>
IV. CASE NARRATIVES

The West Texas District

Computer Equipment, Software and Related Costs
Objectives of Computer Instruction
Student Access to Computers
Teacher Preparation
Student Achievement
Socioeconomic Status of Students
Problems

The North Texas District

Computer Equipment, Software and Related Costs
Objectives of Computer Instruction
Student Access to Computers
Teacher Preparation
Student Achievement
Socioeconomic Status of Students
Problems

Analysis

The West Texas District
Summary for the West Texas District

The North Texas District
Summary for the North Texas District

V. SUMMARY, FINDINGS, IMPRESSIONS, AND RECOMMENDATIONS

Summary of the Study
Findings and Tentative Explanations
Impressions
Recommendations for Future Studies

APPENDIX

BIBLIOGRAPHY
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Expenditures for the West Texas District..................</td>
<td>85</td>
</tr>
<tr>
<td>II. Student Access to Computers in the West Texas District ....</td>
<td>93</td>
</tr>
<tr>
<td>III. Average Daily Attendance in the West Texas District ....</td>
<td>96</td>
</tr>
<tr>
<td>IV. Approximate Percentages of Students Having Access to the Computer-Assisted Instructional Academic Skills Classes in the West Texas District</td>
<td>96</td>
</tr>
<tr>
<td>V. Mathematics Achievement Test Scale Scores for the West Texas District</td>
<td>101</td>
</tr>
<tr>
<td>VI. The Percentage of Students Qualifying for Free and Reduced Price Lunches in the West Texas District</td>
<td>110</td>
</tr>
<tr>
<td>VII. Expenditures for the North Texas District ..................</td>
<td>120</td>
</tr>
<tr>
<td>VIII. California Achievement Test Mean of Achievement Scale Scores Mathematics Total for the North Texas District</td>
<td>146</td>
</tr>
<tr>
<td>IX. Texas Assessment of Basic Skills (TABS) Percentage of Mastery of Objectives Mathematics Subtest for the North Texas District</td>
<td>147</td>
</tr>
<tr>
<td>X. Percentage of Students Participating in the Free and Reduced Price Lunch Program in the North Texas District</td>
<td>163</td>
</tr>
</tbody>
</table>
# List of Illustrations

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flowchart of Procedures</td>
<td>63</td>
</tr>
<tr>
<td>2.</td>
<td>Percentages of Students Using the CAI Lab Each Day in the 1984-85 School Year in the West Texas District</td>
<td>173</td>
</tr>
<tr>
<td>3.</td>
<td>Achievement Levels for Ninth Grade Students in the West Texas District</td>
<td>175</td>
</tr>
<tr>
<td>4.</td>
<td>Achievement Levels for Seventh Grade Students in the West Texas District</td>
<td>176</td>
</tr>
<tr>
<td>5.</td>
<td>A Formal Measure of Socioeconomic Status of Students in the West Texas District</td>
<td>179</td>
</tr>
<tr>
<td>6.</td>
<td>Perception of Parent Attitude in the West Texas District</td>
<td>182</td>
</tr>
<tr>
<td>7.</td>
<td>Responses on Noncognitive Benefits of the CAI Program in the West Texas District</td>
<td>184</td>
</tr>
<tr>
<td>8.</td>
<td>The Number of Hours per Year Students Participated in the Eighth Grade Computer Unit in the North Texas District</td>
<td>194</td>
</tr>
<tr>
<td>9.</td>
<td>Achievement Levels for Eighth Grade Students in the North Texas District</td>
<td>195</td>
</tr>
<tr>
<td>10.</td>
<td>Achievement Levels for Ninth Grade Students in the North Texas District</td>
<td>197</td>
</tr>
</tbody>
</table>
11. Responses on the Noncognitive Benefits of the Computer Unit in the North Texas District ........................................ 200

12. A Formal Measure of the Socioeconomic Status of Students in the North Texas District ........................................ 201

13. Perception of Parent Attitude in the North Texas School District ................................................................. 204
CHAPTER I

INTRODUCTION

Beginning in the 1969-70 school year Texas school districts through guidelines presented in Bulletin 679 Financial Accounting Manual (18) published by the Texas Education Agency have had the opportunity to establish program budgeting and a companion accounting system which records appropriations and expenditures by program. One of the school districts which was a subject of this study initiated participation in this system in the fall of 1974 using secondary science as a pilot program the first year and expanding to all secondary courses in the following year. As consultant for secondary mathematics and science, this researcher was asked to participate in the pilot by the assistant superintendent for finance. Explaining the concept of program budgeting as being a radical departure from the system of budgeting using per capita allotments, he stated that the budget would be developed based on individual program goals, objectives, and needs. Furthermore, the accounting system would be changed to reflect expenditures per program for each year.

Since those early years, many school districts in Texas have followed Bulletin 679 to implement program budgeting
and its accompanying accounting system. One of the benefits of this system has been that it could provide the capability for studies which compared expenditures and achievement by curricular program. Although the information has been collected and preserved in the general ledger of the school district, it has rarely been used for this purpose. The plan for this study included making use of this data.

The subject area for this study was junior high mathematics, and the major reason for this selection was the recent changes taking place in purchases of computer equipment and software for mathematics instruction. Little money was spent for equipment for mathematics instruction during the late 1970's. Then, beginning in the early 1980's funding for computers became acceptable, available, and ever increasing. Traditionally, mathematics teachers have been quite satisfied with a good textbook, ample chalk and chalkboard space. Although there have been occasional slight increases in expenditures when teachers demonstrated interest in supplementary materials such as individualized learning packages, expenditures have been relatively stable for many years.

However, with the increasing popularity and relatively low cost of computers, the situation has changed. In recent years computers have been purchased for use at all grade
levels and for instruction in the basal subjects particularly mathematics as fast as funds can be obtained. Proposals for federal grants, state compensatory funds, and local tax money have been written and approved for the purchase of computers for use in the classrooms for the purpose of increasing achievement in academic areas.

Although there is little doubt students are gaining meaningful experience and knowledge in the use of computers, the question arises if they are gaining in achievement in the basal subjects. An investigation of this question is appropriate, timely, useful to curriculum specialists pondering which directions to take in curriculum design, and valuable to boards of education making policy decisions.

Problem

The problem is the nature of the relationship between computer related expenditures and student achievement in mathematics, with consideration given to the mediating factors influencing this relationship.

Purpose of the Study

It is a common expectation on the part of members of boards of education and the citizens who elect them that spending more money for educational purposes will result in educational gains. Yet many times, current trends,
feelings, and the interests of individuals are the motivations for the appropriation of funds for new instructional programs. The lobbying for the implementation of new programs may come from individual school board members, administrators, teachers, or parents.

Since the expectation does exist and since it does affect policy with regard to educational directions, it is important to investigate the relationship between expenditure and achievement. It was the purpose of this study to investigate the relationship between expenditures for computer equipment, software, and other related costs, and achievement in mathematics. The study was accomplished using qualitative research techniques. Expenditure and achievement data were analyzed, and detailed descriptions of the curricular programs in each of the school districts studied were narrated.

Research Questions

The following research questions were addressed in this study.

1. What is the nature of the interaction between computer-related expenditures and the mathematics achievement of junior high school students who use this equipment as supplements to classroom instruction?
2. How do intervening variables mediate the relationship between expenditure and achievement? Intervening variables include:

a) type of computers and software being used.

b) objectives of computer instruction.

c) teacher preparation in the use of the computer as an instructional tool.

d) amount of time individual students have access to computers.

e) socioeconomic status of students.

Background and Significance of the Study

The Civil Rights Act of 1964 brought about sweeping changes in the educational system in the United States. It also motivated a new direction in educational research which had as its mission the determination of the relationship between educational inputs such as physical facilities, expenditures per pupil, class size, and so on, to student achievement as measured by standardized tests. Coleman (4) and a team of other researchers undertook a massive national research project to examine various school effects, particularly with regard to minority students. The results of this research failed to show any significant difference between school resources and student achievement, except for the most deprived minority students. In this one case attendance
at better schools seemed to result in higher achievement. The implication was that for most students family background and peer relationships seemed to account for more in terms of predicted achievement than did the type of school a student attended.

The Coleman Report, as it came to be known, provoked a flurry of activity by educational researchers. Among those trying to discredit the Coleman Report were Bowles and Levin (3), who claimed that inappropriate statistical techniques had been used and that inadequate sampling returns biased the results so as to repress the importance of school characteristics. Coleman (5) later answered these charges. Although he admitted some weaknesses in the original study, he pointed out that the work had shifted the emphasis of concern from equality of school resources to the more important and socially significant impact of school resources upon children.

In attempting to sort out the emerging maze of research on school effectiveness, Averch (1) examined hundreds of research studies, categorized them into five types, and looked for recurring results upon which he believed educational policy should be based. His conclusions were much the same as Coleman's. He pointed out that since educational resources are not free, and if two resources work equally well, it might be preferable to use the one which
costs less. Furthermore, he encouraged future researchers to include cost analyses in research projects involving school resources. In reviewing studies which fail to show a significant link between cost factors and achievement, he hastened to add that "these results should not be interpreted as indicating that school resources do not affect student outcomes . . . only that these studies have failed to show that school resources do affect the student outcomes" (1, p. 48). He also argued that the measurement of educational outcomes should be broadened to include other noncognitive factors such as motivation, attitudes, learning styles, social skills, and even happiness.

The mid-to-late 1970's saw the school finance reform movement further motivating the investigation of the relationships between school resources and student achievement. Tallmadge (17) studied per pupil expenditures and student achievement for Title I schools in California, and Fowler (7) merged finance information with achievement scores obtained from the New York State Education Agency's database. Both tried to correct for socioeconomic status of students and also the effects of prior achievement. Both failed to show significant relationships except possibly for minority, low achieving students for whom the increased expenditures did seem to make a difference with regard to
achievement. Each of these researchers reported difficulties with the data which could have biased the results. Tallmadge believed that unstandardized statewide testing data and nonuniform accounting practices may have contributed to a substantial amount of random error in his study. Fowler indicated that the use of mean school district data could have masked individual school differences. He would rather have used school level rather than districtwide data.

Also emerging in the late 1970's and early 1980's was research relating the use of computers used for classroom instruction and student achievement. Many of these studies were also involved with Title I programs or with students who were behind in grade level achievement in the basal subjects. Ragosta (15) was one of those who reported on the use of computers in the Title I mathematics classes in the Los Angeles schools. She was able to show that computer assisted drill and practice programs were effective in raising the scores of students in mathematics computation.

However, this type of research has not focused on Title I projects solely. The research has broadened to include copyrighted instructional programs such as those available through Computer Curriculum Corporation and the mathematics program included in Programmed Logic for Automated Teaching Operations (PLATO). DeVault (6) reported on the successes of these in a review of a number of research projects. He
summarized studies which showed that students using computers had significantly greater gains in mathematics achievement than did those in control groups. Kulik (10) also reported the results of his meta-analysis of research findings on computer-based instruction, showing students' grades improving, and better student attitudes about school. His results also indicated higher effects for disadvantaged and low aptitude students.

Not only is there an abundance of evidence of the effectiveness of the use of computers for classroom instruction, but also there is ample indication that school districts all over the nation are purchasing computers as fast and in as great a quantity as available funds will allow. Moreover, the rush has been overwhelming to some teachers and principals who were not prepared or trained for the onslaught. Marcom and Bellew (11) reported that the number of computers in the nation's schools rose by 60 percent in the 1984-85 school year, bringing the number of computers to a total of over one million costing over two hundred fifty million dollars.

Two points support the significance of further research. First, many researchers over the years have recognized the need to relate educational expenditures to educational outcomes for effective pedagogical and fiscal decision-making. Second, there is much research evidence to
support the use of computers as a valuable instructional tool in either increasing achievement of students or in making their learning more efficient. Also, it is abundantly clear that many school districts are purchasing classroom computers as rapidly as possible. Consequently, this unique situation where a large infusion of money designated to support a specific educational program provided a new opportunity to study the relationship between cost of a particular program and the achievement of students who participated in this program. The research design also furnished the vehicle for analyzing the mediating factors which influence these two elements.

Averch (1) emphasized the impact of research upon policy decisions. More recent writers have noted the effects of public opinion upon policy. West (20) for one reviewed a 1982 Gallup poll which indicated that most people believe a solid educational system is more important than expanding military strength. He also pointed to the report of the National Commission on Excellence in Educational which revealed alarmingly high percentages of functionally illiterate young people in the United States. With costs for education increasing and school enrollments together with student achievement declining in the decade between 1971 and 1981, West indicated that public support for the educational system is in danger. He reconfirmed that recommendations of
the researchers of an earlier period that research on school effectiveness should take new directions.

Murnane (13) also supported a redirection of research on school effectiveness. He stressed the value of a more holistic approach to research which considers not only school resources and facilities but also such intrinsic variables as motivation of teachers and students and behaviors of school personnel. Viewing one of the major problems in setting school policies as that of "providing more children with the school resources that contribute to rapid learning," Murnane went on to add that "part of the difficulty in fulfilling this task stems from our limited understanding of what these resources are" (13, p. 26).

Methodology

Research design provides a method for a redirection of research in education. Recognized for many years in the fields of anthropology and sociology, qualitative research is emerging in recent years as a valid method in educational research as well. Although qualitative research defies specific definition, many writers describe its characteristics. The most important aspect of the method is the setting in which the research is conducted. Goetz (8), Patton (14), and Bogdan (2) among others emphasize that the studies are done in a natural setting so the researcher can
observe people in their own environments, taking note of their behaviors, attitudes, and customs. Stake claims that studies conducted in this setting and analyzed in a practical way appeal to the reader's own experience and thus provide "a natural basis for generalization" (16, p. 5).

Patton describes qualitative data as that which proliferates in "detailed descriptions of situations, events, people, interactions, and observed behaviors; direct quotations from people about their experiences, attitudes, beliefs, and thoughts; and excerpts or entire passages from documents, correspondence, records, and case histories" (14, p. 22).

Stake (16) supports qualitative research in particular the case study method as being a means of adding humanistic understanding and the extension of experience to educational research.

This study was designed using the qualitative techniques of a case study method. The purpose of the selection of this design was to try to bridge the gap left by quantitative studies of the past which have failed to confirm the relationship between school resources and student achievement. Where quantitative studies have narrowed the scope of investigation in an attempt to eliminate variables which cannot be controlled, this researcher attempted to broaden the range of allowable data in order to seek a deeper understanding not only of the relationship between
expenditures and achievement but also of the mediating factors influencing them. The best reinforcement of this selection comes from quantitative researchers such as Coleman (4, 5), Averch (1), and Fowler (7) who called for new directions in research, studies which considered more than the lower cognitive outcomes, and investigations which are more sensitive to the subtle elements which influence children in their environments.

Assumptions

It is assumed that the use of computers and software as instructional tools in the classroom is a valid way of increasing achievement. Many studies support the concept that achievement is improved with the use of alternative methods of instruction including the use of computers.

Since the study investigates the relationship between achievement and expenditures for computers and software, it is assumed that computers found in the schools are used, and that the primary use of the computers in the classroom is for the purpose of computer assisted instruction and not the use of computers as a management tool for teachers.

Limitations

Two Texas school districts were selected for this study. The results reported may not be generalized in order to describe or predict programs in other school districts in Texas or elsewhere.
The possibility of bias is always present in a qualitative study, bias not only on the part of the researcher but also on the part of the subjects of the study. However, the researcher sought to reduce the significance of this limitation by using a variety of data collection techniques including observations, interviews, and document analyses in order to provide a cross-check of reliability and triangulation of results. The use of extensive quotations not only from the interviews but also from the documents collected adds validity to the results because the reader has the opportunity from reading the data to confirm the conclusions of the researcher.

Definitions

Junior High refers to a school with grades seven, eight, and nine.

Computer Assisted Instruction in mathematics education describes computer technology used for drill-and-practice programs, instruction in mathematical concepts, problem solving, and computer programming.

Expenditures are those costs designated specifically for computers, computer software, and other computer related costs such as those for paper, ribbon, and maintenance and repair. It does not include any costs for facilities such as those costs related to furniture or school plant. Neither does it include salary costs.
Computer refers to micro or mini-computers used exclusively for classroom instruction. It refers to machines capable of internal memory of 4K RAM or better.

Population

The population was comprised of junior high schools in each of two school districts in Texas. The districts were chosen on the basis of criteria which included size, the use of computers for classroom instruction, junior high school organization, standardized accounting practices, consistant testing programs, and acceptance of the research proposal. Both districts were ranked among the twenty-five largest districts in the state. The one located in west Texas had six junior high schools, and the other located in north Texas had eight junior high schools which participated in the study. The districts exhibited both similarities and differences. Both have substantial tax bases to allow for the purchases of such "extras" as computers for classroom instruction and have made a commitment to this program by appropriating funds, organizing a districtwide computer program, selecting staff to manage it, and providing inservice to principals and teachers for its implementation. The differences are mainly in population demographics. The north Texas district serves a dense population living in a suburban, ninety-four square mile area,
while the west Texas district is a county district serving a population which is spread out over more than nine hundred square miles.

Procedures for Data Collection

Following the procedures outlined by Bogdan (2), Goetz (8), Patton (14), and others for the collection of qualitative data, this study made use of a variety of techniques. Goetz in particular emphasizes the importance of a multiplicity of data sources since "data collected in one way can be used to cross-check the accuracy of data gathered in another way" (8, p. 11). Using the case study approach the data were collected during observations in fourteen junior high schools in two school districts, during formal taped interviews with principals, teachers, and students, and during informal meetings with central office administrators. Although the most voluminous part of the data consisted of the transcriptions of the taped interviews, another very important part of the data collected was the documents provided by central office administrators. Documents included curriculum guides, general ledgers, copies of budgets and purchase orders, tabulations of test scores, and reports containing attendance data and the number of students participating in the free and reduced price lunch program.

The interviews were conducted using focused interview schedules designed to capture the particular points of view
of principals, teachers, students, and curriculum coordinators. Bogdan (2) suggested that although the research design should be an evolving process especially during the field work stage of qualitative research, the use of interview schedules is helpful in multi-site or multi-subject studies where consistency of data is a concern. In the west Texas district the director of secondary education made the arrangements of the dates and times for the visits to the six junior high schools involved in the study. In the north Texas district the researcher made these arrangements directly with the principals of the eight junior high schools participating in the research. The data collection phase of the study took place in a three-month period during the spring and summer of 1985.

Data Analysis

Miles (12) described data analysis as being a three-step process: data reduction, data display, and conclusion drawing and verification. Working with elaborated field notes and verbatim transcriptions of tapes totaling over four hundred pages, the researcher coded these data according to a list of coding categories which were designed to focus not only on the research questions but also upon unanticipated and merging trends that became evident during the coding process. As Miles noted, "Codes are categories,"
usually derived from research questions, key concepts or important themes. "They are retrieval and organizing devices that allow the analyst to spot quickly, pull out, then cluster all the segments relating to the particular question, hypothesis, concept, or theme. Clustering sets the stage for analysis" (12, p. 56).

The data display portion of the analysis was accomplished through the use of narrative text, matrices, graphs, and charts. All the numerical data were displayed using matrices, graphs, and charts. Matrices were further utilized to reduce the narrative text to coded characteristics which aided in conceptualizing the themes. Using the constant comparison and analytic induction techniques described by Goetz (8), merging trends and developing themes were identified bringing the data analysis to the third phase of conclusions and verification. Various data sources helped to cross check the accuracy and increase the validity of the conclusions. The use of primary data in the form of many quotations from participants provided reliability of the researchers findings because they can be checked by any reader of the study.
CHAPTER BIBLIOGRAPHY


2. Bogdan, Robert C. and Sari Knopp Biklen, Qualitative Research for Education An Introduction to Theory and Methods, Boston, Massachusetts, Allyn and Bacon, 1982.


CHAPTER II

REVIEW OF RELATED LITERATURE

Expenditures and Achievements

Many researchers have turned their attentions to studying the effectiveness of schools. Input-output or production function studies, as they are sometimes called, which analyze the effect various school characteristics have upon student achievement can be found in the literature as far back as the 1950's. It was, however, school desegregation and the civil rights movement which gave national attention to the differences in school environments and the probable effects upon disadvantaged and minority students. Although there is research in this area which predates the 1964 Civil Rights Act, probably the most comprehensive and widely recognized study was that conducted by Coleman (5) and others as a result of Section 402 of the Civil Rights Act which mandated the U. S. Commissioner of Education to, conduct a survey and make a report to the President and the Congress, within two years of the enactment of this title, concerning the lack of availability of equal educational opportunities for individuals by reason of race, color, religion, or national origin in public educational institutions at all levels in the United States (5, p. 111).

Hence, the Coleman report titled "Equality of Educational
Opportunity" is really a search for inequality in the nation's schools.

Using data collected in 1965 from surveys and tests for 645,000 students, a survey and a short test of verbal facility for teachers, and surveys to principals and superintendents in about 3100 schools, Coleman investigated characteristics of schools, student bodies, and teachers. He attempted to calculate the relationships between achievement and school characteristics, the inference being that if the quality of schools could be improved perhaps the achievement might be increased for disadvantaged students. His conclusions were "that variations in the facilities and curriculums of the schools account for relatively little variation in pupil achievement insofar as this is measured by standard tests" (5, p. 22). He did go on to mention that indirect evidence suggests that school factors seem to make a difference in the achievement of minority students, particularly Negro students in the south. For this group of students "achievement is appreciably lower in schools with low per pupil expenditure than in schools with high expenditure" (5, p. 312). Coleman notes, however, that adjusting the data to remove varying student body factors may have caused the variation due to expenditure to have vanished for this group.
As might be expected, the Coleman report has been the basis for much controversy, evaluation, and further research. Bowles and Levin among others labeled the report as a "major challenge to American education" (3, p. 4). Although acknowledging the strength of the Coleman report as being a significant stimulus for thought and new research efforts, they primarily pointed to the weaknesses of the study. Citing two factors as errors in the data, first, sample response with a disproportion of large city schools failing to respond and second, a large number of non-responses on individual questionnaire items, and also citing as errors the use of inappropriate statistical techniques, they claim "the research design was overwhelmingly biased in a direction that would dampen the importance of school characteristics" (3, p. 8). Another source of bias was the use of district level, rather than individual school level, expenditures, a fact which reduced variance and understated the effect of per-pupil expenditure.

Coleman (6) himself responded to some of the criticisms aimed at his massive study. Two years later after its completion, he answered the charge that the original study attempted too much and failed to address the minimum requirement of identifying inputs which would provide adequate measures of educational equality. He claimed the 1966 study even with its shortcomings shifted the emphasis of
describing accurate resource inputs for minority students to the more socially significant evaluation of the benefits received by individual children. Coleman pointed out that although school districts may distribute resources equally to the schools in the district, children may not receive the inputs equally, and that this "difference between inputs as disbursed and inputs as received" (6, p. 11) creates enormous difficulties to the researcher. He concluded that studies should include both views of inputs of resources, those from the administrator who distributed them and those from the children who received them. His research measured the inputs as disbursed rather than as received. Acknowledging the inadequacy of a massive study using a general sample of schools and students for answering specific policy related questions, Coleman encouraged researchers to use other methods to study this relationship. He also recommended analysis of longitudinal data as collected by schools and other social institutions.

It appears that the most promising possibility for policy research lies in much more systematic and careful administrative records of social institutions. These records, if they are well-maintained and comparable among schools, would allow analyses for policy questions to be carried out regularly and at minimal cost, by local school systems, by state systems, or nationally (6, p. 37).

In 1971 Harvey A. Averch and others (1) published their final report to the President's Commission on School Finance
which assessed the body of knowledge at that time on the
determinants of educational outcomes or educational effec-
tiveness. They did this by conducting a critical survey of
research, and the purpose was to try to fill the gap between
educational research and educational policy. Realizing that
policy should not be determined based on a single study,
they categorized research studies into five different
research approaches and looked for results that appeared
consistently through a number of studies. The first of
these, the input-output approach, is typified by a body of
data, usually survey data collected at one point in time,
and analyzed using statistical methods. The researcher uses
the results of the statistical analysis to try to make
statements about the effects of educational resources or
inputs. Coleman's (5) work fits into this category.
Although Averch found that "school resources are seldom
important determinants of student outcome" and that "no
school resource is consistently related to student outcomes"
(1, p. 44), he was quick to point out that "these results
should not be interpreted as indicating that school
resources do not affect student outcomes . . . only that
these studies have failed to show that school resources do
affect student outcomes" (1, p. 48).

Averch (1) concluded his analysis of research studies
by making several important points important to this current
study. First, studies have not shown what the results would be if schools received massive increases or decreases in resources. Second, educational researchers have focused on discovering effective educational practices while paying little attention to their costs.

The role of resource prices in the formation of educational policy is often overlooked. Even those researchers who recognize the importance of resource prices in their theoretical discussions do not introduce them into their empirical analyses. But school resources are not free and school systems do not have unlimited budgets. Consequently, the important questions from the viewpoint of the educational policymaker are not: How much does resource 1 contribute to student outcome? Rather, educational policy makers must ask: How much of resource 1 should be purchased (1, p. 34)?

Third, student outcomes are usually measured in terms of achievement or cognitive skills. Yet, Averch points out that most educators agree that noncognitive factors such as "motivation, attitudes, learning styles, social skills, self-awareness, and even such vague but important concepts as happiness and quality of life" (1 p. 16) are also important to educational outcomes. Fourth, all of these points will force educators to make detailed descriptions of what is taking place in the classroom over a period of time. These may provide a basis for effectively redirecting scarce and costly educational resources.

Although many researchers have substantiated the findings of Coleman (5), Averch (1), and others that school
resources account for little if any of the differences in student achievement, few it seems, want to believe them. A number of researchers have tried to document exceptions to this disturbing conclusion. Tallmadge (19) for one analyzed the relationship between reading and mathematics achievement gains and per-pupil expenditures in California Title I programs for fiscal year 1972. Using statistical controls which remove the effects of regular expenditures, schools with less than 25 per cent eligible Title I students (unsaturated schools) showed significantly greater gains in reading and mathematics achievement and higher per-pupil expenditures for Title I students than did schools with 75 percent or more eligible Title I students (saturated schools). Although the saturated schools showed a significant relationship between reading achievement (but not mathematics) and per-pupil expenditures, no relationship was found to exist between achievement in either reading or mathematics and per-pupil expenditures in the unsaturated schools. Tallmadge indicated that the use of unstandardized statewide data may have contributed a substantial amount of random error, pointing to inadequate and unstandardized accounting practices, the use of a variety of different achievement tests, and nonuniform testing intervals. Emphasizing that cost-benefit analysis is both complex and controversial for compensatory funding, Tallmadge added:
To date there has been no adequate analysis of the relationship between cost and effectiveness in California or anywhere else. Nor does it seem likely that the issue will be adequately dealt with in the near future, as to do so would be an undertaking of vast proportions. On the other hand, each study completed to date, if interpreted with full consideration of its strengths and weaknesses, expands our knowledge relative to this important issue. Each study, furthermore, suggests new ways of gathering additional information and addressing new aspects of the overall question (19, p. 4).

Whereas the years following the Civil Rights Act of 1964 and subsequent funding for Title I programs produced the incentive for research relating achievement and expenditures for compensatory education, more recent years have seen this interest fueled by the school finance reform movements. Fowler (8) in his study which merges test and finance data for 705 school districts in New York State indicated that results supported both sides of the issue. Median district test scores did not seem to be influenced by per-pupil expenditures used to purchase typical school facilities and curricular programs. However, Fowler's study did indicate that for students performing two or more grade levels below their peers, expenditures did seem to make a positive difference. His studies differed from preceding ones (e.g., Kiesling's (11) work in the 1960's) in that he statistically controlled for the socioeconomic status of students and also for their previous achievement. Fowler (8) also used median district test scores since this was all
that was available to him from the state's data base. He did indicate concern that this could have masked within school differences which might influence student achievement. He also indicated that his study would have been strengthened if he could have had socioeconomic measures by grade level rather than district averages and if he could have used grade level scores over a period of three or more years. One explanation for the result that school characteristics for the majority of students did not seem to make a difference in achievement was the sameness of school environments. Fowler noted, "far from being weak and ineffective", school environments "are so uniform and effective and schooling so similar, that the greater variability of non-school variables will correlate more highly with differences in student outcomes" (8, p. 19).

Like Tallmadge (19), Fowler (8) also emphasized the need for research relating achievement and expenditures. He believed, "unless it can be demonstrated that money affects test scores, intra-state disparities, disparities between minorities, and intra-school disparities are of dubious concern" (8, p. 3). He went on to say that unless they were convinced to do otherwise, property poor districts may use additional state funds to lower their tax rates rather than raise their per-pupil expenditures. Fowler suggested that a
redirection of research on educational effects which maximizes the range of school environment variation and which uses more sensitive measures might be a better way of studying this elusive relationship.

Computer Curricula and Achievement

Just as much of the literature analyzing the effectiveness of schools as it relates to inputs such as expenditures has been initiated by the need to improve schooling for disadvantaged and minority students, the same is true of the studies which relate curricular programs to student achievement. Since the beginning of the Title I programs, school districts have sought ways of focusing on individual student needs and providing individualized programs to serve those needs. Many have seen computer technology as a means to this end. Lavin (13) reported on a three year research study to evaluate the effectiveness of Computer Assisted Instruction (CAI) for Title I/Chapter I programs in six school districts in Massachusetts. Positive results were reported for mathematics achievement gains when used to supplement classroom instruction.

Ragosta (16) reported a five year study conducted in the Los Angeles Unified School District to evaluate the effectiveness of CAI in the Title I programs. This study funded jointly by the National Institute of Education and
the Los Angeles Schools indicated the CAI drill and practice programs provided significant treatment effects to improve students computational skills in mathematics in grades one through six. Not only were the treatments significant for the one year programs, but also treatment effects increased for the CAI uses over two or three years.

In a review of research on computer assisted instruction in mathematics education DeVault (7) cited two extensive research projects of the 1970's. One was conducted by the Computer Curriculum Corporation (CCC) and the other was for the mathematics instruction program included in Programmed Logic for Automated Teaching Operations (PLATO). Results of the CCC research indicated time spent at CAI terminals was positively related to achievement, and actual gains exceeded expected gains in mathematics achievement. Research for the PLATO users indicated similar results, with children using the computer showing significantly greater gains in mathematics achievement than children in control groups. DeVault (7) summarized nine other studies comparing achievement and attitudes of students using computers to students not using computers for mathematics instruction. Two of the studies yielded positive significance for achievement and seven yielded positive significance for attitude of students using computers. Typical attitude measures were those which compared
students' perceptions of computers to their perceptions of teachers and textbooks as modes of instruction.

Other reviewers of research literature report similar findings. In their meta-analysis of findings of computer-based instruction Kulik, Bangert, and Williams (12) found that computer-based teaching raised scores on final exams and contributed toward a positive attitude of students toward computers and toward the courses they were taking. The more recent the studies, the stronger were the effects on achievement. Studies of shorter duration produced stronger effects than studies of longer duration. They also found that computer-based teaching had higher effects for disadvantaged and low aptitude students.

Suydam (18) commented that computers have been so willingly accepted in the last few years that efforts lately are focused more on developing computer activities and materials than on research to support the validity of their use. In Garland, Texas, citizens approved a 6.5 million dollar bond issue to buy computers for the schools. A full page advertisement in a recent issue of Time (21) magazine featured Lynne Rigg, Assistant Director of Curriculum in Garland, announcing the commitment of the 6.5 million dollars for the purchase of Wicat Systems computers and software to be used by 30,000 students in kindergarten through twelfth grades. Explaining the Garland program in
the September, 1984, issue of *Texas School Business*, Deborah Bryant (4) elaborated that the purchase was the result of a study started in 1982 by the superintendent through the work of a computer committee. The computers would be used in classrooms to provide drill and practice, tutorial and simulation experiences, and to teach computer literacy. In recommending the program adopted and purchased by the district, the committee was convinced that "CAI (computer-assisted instruction) does make a difference in student learning rate, learning retention, and general achievement" (4, p. 4).

The Garland Independent School District is not alone. School districts all over the country are endorsing this latest educational trend, computer-based teaching, promising big gains in academic achievement, and spending millions of dollars. Hertz (9) proposes that "in today's society it is tantamount to educational heresy to suggest that anything short of unqualified, unbridled, headlong plunging into the purchasing of computer equipment is appropriate" (9, p. 8). Testimonials from teachers and administrators on the motivational values, changes in attitudes, and gains in achievement attributed solely to the acquisition and use of classroom computers are widely available in the literature.

For example the January, 1984, issue of *Instructional Innovator* (2) spotlights six school districts selected from
125 nominations which use computers in the classroom. These school districts are Cincinnati Public Schools; Alexander Local School District, Albany, Ohio; Cupertino Union School District, Cupertino, California; Ann Arbor Schools, Ann Arbor, Michigan; Fairfax Public Schools, Fairfax, Virginia; Plains Public Schools, Plains, Montana. The editors of this publication cite a recent national survey which shows that 70 percent of all school districts in the United States use computers for instruction, a figure which had doubled over the previous year.

Rising (17) notes that very frequently the academic area targeted first for the use of computers is mathematics. Historically, the first interests in computer equipment have sprung from departments of mathematics, and mathematics teachers have sustained computer applications and computer instruction. Consequently, it is a natural occurrence that administrators would focus on mathematics achievement for the justification of large purchases of computer equipment. For example Ann Arbor's (2) 14,500 students have 400 microcomputers which are used for drill and practice in math and science. In junior high schools, computer use is emphasized in mathematics with all seventh graders participating in a two week programming course and eighth graders writing and using programs especially in mathematics classes. The Fairfax, Virginia (2), schools have a one million dollar
annual budget for teacher training and computer equipment which comes from the local school budget, private contributions, and federal block grants. Teachers in the Plains, Montana (2), schools felt they were cheating their students by not having computers. Since there was not enough money for computers for all academic areas, they decided to concentrate on mathematics, science, and business.

DeVault (7) provides a comprehensive categorization of computer technology used in mathematics education. His two categories are Computer Managed Instruction, which is not an instructional use, and Computer Assisted Instruction (CAI) which includes drill and practice programs, instruction in mathematical concepts, problem solving, and computer programming. Zakariya (24) looks at the types of schools which have computers and the uses in which the various types of schools concentrate computer instruction. Pointing out that two-thirds to three-fourths of the richest U. S. schools have at least one computer and about 60 per cent of the poorest schools have none, he notes that this latest surge in the use of technology may actually "perpetuate, or even exacerbate, traditional inequities in education" (24, p. 29). Not only do the large, rich, suburban school districts have the preponderance of the computer equipment, but also their concentrated use is different from that of the lower socioeconomic status schools. Chapter I schools
are more likely to use computers for drill and practice in the basic skills, while more affluent schools use them for teaching programming and enriching the curriculum. He reports that teachers feel the above-average students learn the most from using the equipment, and that unless specific efforts are made, minorities and students from the less privileged backgrounds will not use computer equipment as much as other students.

Although many educators and researchers are enthusiastic about the use of computers in the classroom, others are wondering where the rush to buy classroom computers is leading. Marcom and Bellew (14), staff writers for the Wall Street Journal, report that during the 1984-85 school year the number of computers in the schools increased by 60 percent at a cost of more than $250,000,000, bringing the total number of computers in United States public schools to more than 1,000,000. They reported interviewing school principals who were overwhelmed by the equipment and did not know what to do with it. Instructional programs in many schools have been focused on the teaching of computer literacy, which exposes students to the computer and its various uses such as word processing. In other words the machine itself was an object of study. Critics of these courses claim that the technology is changing so rapidly and
computer usage is becoming so easy for the novice user that courses of this type will soon be obsolete.

Another serious problem in using computers for classroom instruction is the shortage of teachers who understand both their subject area and are competent in computer technology. Even teachers who are experienced in both may not know how to select software programs that are appropriate for classroom use. Furthermore, software programs are so expensive that after the schools have purchased the computers, there is no money left to buy software. In spite of these problems, spending is expected to continue and at even greater rates. California's Education Department is budgeting $42,000,000 for teacher training and software to be spent in the 1985-86 school year. United States Representative Timothy Wirth, Democrat from Colorado, is introducing a bill in the United States Congress to spend $340,000,000 to buy computers over the next ten years in various poorer school districts around the country.

Marcom and Bellew (14) conclude by pointing out that regardless how schools use the computers, there is no doubt that computers will have a huge influence on public school education. They theorize that parents who are dissatisfied with the public schools may view home instruction using computers and software as an alternative means of education for their children.
Importance of Further Study

The preceding review of the literature has been done to make two points relative to the extant study:

1. There is a need to relate educational expenditures to achievement, and this need is recognized at various levels of government and by researchers with differing points of view. The reason for this concern is that the conclusions will influence policy directions.

2. There is much research evidence that computer-assisted instruction is a valuable instructional tool at least for some categories of students. There is also abundant evidence that educational funds are being spent for computer equipment and related costs and that expenditures are rapidly increasing. Consequently, this unique and rapidly developing circumstance provides an opportunity to link educational expenditures to achievement and to study the relationship of the mediating factors which bind together this linkage.

In reviewing the research studies undertaken prior to 1971 Averch emphasized the importance of setting educational policy based on the consensus of many studies. He reiterated, "educational policy cannot be based on the results of any one study" (1, p. 35). Noting that school systems have traditionally been willing to pay a premium for such school resources as smaller classes, teachers with
experience, and teachers with advanced degrees, he also indicated that research to that date had not supported the value of these practices in terms of increased student achievement. He also noted that a limitation of many research studies on school effectiveness is the failure to include the cost considerations of the school resources being applied. After surveying the available research on school effectiveness, Averch reached three policy implications:

1. Research has not identified a variant of the existing system that is consistently related to the students' educational outcomes.

2. Increasing expenditures on traditional educational practices is not likely to improve educational outcomes substantially.

3. There seem to be opportunities for significant reduction or redirection of educational expenditures without deterioration in educational outcomes (1, pp. 154-5).

Policy regarding public education is influenced by public opinion. Edwin G. West (23) pointed to conclusions drawn by the National Commission on Excellence in Education in its 1983 report on the state of education in the United States. The report revealed that thirteen per cent of all people who are seventeen years old and forty per cent of minority young people are functionally illiterate. In addition to being weak in reading in terms of drawing inferences from written material, nearly one-third of all persons
seventeen years old cannot solve a math problem requiring more than a few steps. West also referenced a 1982 Gallup poll in which every major population group indicated that a solid educational system is more important to the country than is advancing the industrial system or expanding military strength.

With competency in the basic skills declining for high school graduates and the cost of public education increasing, West (23) predicted that many more people will lose confidence in the public schools and will send their children to private schools. Using inflation adjusted figures West noted that the cost for public school education rose eight per cent in the decade between 1971 and 1981. This, he commented, would have been reasonable if either enrollments or student achievement would have increased by some figure close to eight per cent. However, both declined. Enrollment dropped eleven per cent, and student achievement fell during that period as measured by S.A.T. scores.

West (23) alluded to input-output research studies of the past which concluded that schools make little difference in the educational achievement of students and that peer and family influences account for most of the differences. However, he went on to indicate that more current research
shows that schools are heterogeneous and some do make a difference. The newer research focuses more on the behaviors of school personnel rather than on school facilities. The factors that seem to influence student achievement are such teacher actions as preparing the lesson in advance, beginning the class on time, consistently assigning and grading homework, and encouraging students by telling them that they can learn.

Richard Murnane (15) also recognized the shift in educational research on school effectiveness from the capital intensive studies of the 1960's and early 1970's to more emphasis on other school factors. Researchers who assume a more holistic approach taking into account not only the physical facilities of the school, but also the composition of the student body, and the degree of talent and motivation of the teachers were able to conclude that schools do make a difference. Although Murnane indicated that more current researchers view such characteristics as physical facilities, class size, curricula, and instructional strategies as secondary resources, he theorized that the better, more highly motivated teachers and students may gravitate to these schools. Thus, in a sense, these characteristics have had an influence on student achievement. The policy problem as Murnane sees it is,

how to design policies that will provide more children with the school resources that contribute to rapid learning. Part of the difficulty
in fulfilling this task stems from our limited understanding of what these resources are. However, research results provide increasing guidance concerning the resource configurations that are associated with high rates of student learning in ongoing educational systems (15, p. 26).

Researchers in the area of computer-assisted instruction point to that mode of teaching as a resource which contributes to rapid learning. David B. Thomas (20) in his review of research studies on the effectiveness of CAI programs which were reported prior to 1979, cites the studies of Toggenburger and McDaniel (22). In the area of mathematics, language arts, and reading at the junior and senior high levels, they report that although achievement levels were not increased, "the growth was 50 per cent better than that obtained prior to the introduction of CAI" (20, p. 105). A number of other studies reviewed by Thomas did report significant levels of gain in achievement and "overwhelmingly support CAI as a viable instructional alternative . . . equal to or better than traditional methods" (20, p. 106). Further, students seemed to like working with the computer more than using traditional instructional methods. One study reported reduced truancy, tardiness, and vandalism for minority students after CAI was introduced. In addition to the achievement and attitudinal benefits Thomas also adds that "CAI study reduces the time required for a student to complete a unit" (20, p. 109).
Taking a different approach on the need for improving the effectiveness of the educational system Herch (10) says that to be technologically illiterate is to experience technology as a tyrant and to suffer from factual obsolescence. . . . Individuals who cannot read and write well, who have no sense of the major human questions, and who show no interest in continuing to learn will increasingly risk technopeasantry. They will be ill-equipped to contribute to the technological advances essential to regaining a competitive advantage in world trade; they will be ill-equipped to participate fully in a technological society (10, p. 637).

Like West (23), Herch (10) cites recent trends in educational decline and warns that continued regression will threaten the survival of the United States economy. He says that education is so important to the national well-being that improvement in the public school system is a requirement. Viewing the investment in human capital as an economic necessity, Herch insists on redefining literacy by including into its scope an increasing knowledge-based aspect of technological illiteracy. Also alluding to recent research which supports the idea that the most effective schools have instructional personnel who care about students, prepare for classes, assign and check homework, insist on an orderly, well-disciplined environment, and who positively encourage student achievement, Herch recommends that the federal funding of educational programs should "be mediated
by our growing knowledge of the factors that increase student achievement" (10, p. 638).

Summary

Researchers for many years have recognized the need to relate resources provided to students to the benefits received by those students in terms of their achievement. The reasons for this need are that school resources are not free and that educational benefits received by students impact not only the national economy but also the national destiny in a significant way. Consequently, educational policy is influenced by the demonstration of this relationship. Although research has been supported at a national level and been conducted by recognized researchers, traditional methods have failed to show significant relationships between school inputs such as school facilities, the number of library books in the library, teacher pay, etc., to student achievement as measured by standardized achievement tests. More recent studies have broadened the research on school inputs to include such teacher behaviors as preparation for classroom presentation, consistency in checking homework papers, maintaining order in the classroom, and encouraging students to do good work.

Much research has also been done to show the effectiveness of the use of the computer as an instructional
tool. Not only does it seem to be effective but also there is widespread evidence that many school districts are making use of this technological tool. The reasons for this seem to be twofold. First, the rapidly expanding computer market has resulted in substantial price reductions making them affordable even in school districts with tight budgets, and second, the public not only seems willing to accept and support the use of the computer for classroom instruction but in many places demands it. Furthermore, there is research evidence to support the use of computer-assisted instruction as a method which raises achievement levels of some categories of students or expedites their learning process or both. It becomes a question then not of whether this resource should be purchased for the schools but perhaps a question of how much.

Studies of the past have failed to show a significant relationship between expenditures and achievement. Recent studies support the use of computers as an instructional tool, and many school districts are appropriating and spending thousands of dollars to implement computer-assisted instruction in the classroom. This situation provides a unique opportunity to link expenditures to achievement at least in one type of curricular program. A study which considers longitudinal data over a multi-year period may find trends which parallel increasing expenditures for computers with increases in student achievement.
CHAPTER BIBLIOGRAPHY


AEDS Journal, 12 (Spring, 1979), 103-115.


   Educational Users Group, 7 (May, June, 1977), 70-74.


24. Zakariya, Sally Banks, "In School (As Elsewhere), the Rich Get Computers; the Poor Get Poorer," The 
CHAPTER III

RESEARCH METHODOLOGY

Introduction

After the selection of a topic for inquiry, every researcher is faced with the choice of research design and the determination of the research methodology which best suits the problem to be studied. Borg (3) lists several types of research available in educational investigation: survey research, observational research, historical research, causal-comparative research, correlational research, and experimental research. Emerging in recent years as another viable educational research method is qualitative research. Long recognized in the fields of anthropology and sociology, where time spent by the researcher in a natural setting, making observations, studying attitudes, describing events and customs, examining documents, and talking with people in their own environments, qualitative research has come to be accepted as applicable in the educational setting as well. Wilson (12) makes a case for the use of ethnographic or qualitative techniques in the educational context by noting that it is "just as valuable for mainstream American schools as for
those in other cultures." He goes on to add that "the National Institute of Education is encouraging this kind of approach, and many researchers involved in the evaluation of educational programs and in the processes of innovation are finding these approaches useful" (12, p. 246). Indicating that anthropological techniques provide a means of gathering data about human behavior that is impossible to obtain by more quantitative methods, he believes that research about schools should be done in the school setting where the forces exerted on participant behavior are intact.

Patton (9) describes qualitative data as that which consists of "detailed descriptions of situations, events, people, interactions, and observed behaviors; direct quotations from people about their experiences, attitudes, beliefs, and thoughts; and excerpts or entire passages from documents, correspondence, records, and case histories" (9, p. 22). Comparing quantitative and qualitative measurement, Patton explains that where quantitative studies rely on standardized instruments which limit the scope of the data, qualitative data collections are open-ended narratives which purposely disallow the standardized categorization of program activities or the experiences of people. The purpose of this technique is to gain depth of understanding and detail in description.
Stake also supports qualitative research, in particular the case study method, which he says "proliferates rather than narrows" (10, p. 7). Furthermore, he claims that "case studies will often be the preferred method of research because they may be epistemologically in harmony with the reader's experience and thus to that person a natural basis for generalization" (10, p. 5). Social inquiry is carried out not just to add to the research literature but to help people who work in schools, governments, and industries to further their understandings of social problems. The most effective means of doing this will be "by approximating through the words and illustrations of our reports, the natural experience acquired in ordinary personal involvement" (10, p. 5). If the aim of educational research is understanding, increase in knowledge, and extension of experience, then he says that truth in the fields of human endeavors is best approximated by declarations that are immersed in the feelings of human encounter. Knowledge which is gained through tacit experience is called naturalistic generalization and develops within people an added sense of humanistic understanding.

Methodology

Many researchers who have investigated the relationship between school characteristics and student achievement have
recognized the shortcomings of research which is solely statistical. Even Coleman (4), who conducted the first major national survey since the sweeping changes brought on in the public schools as a result of the Civil Rights Act of 1964, acknowledged this weakness. In regard to the general character of school environments he said,

> Any statistical survey gives only the most meager evidence of these environments, for two reasons. First, the reduction of the various aspects of the environment to quantitative measures must inherently miss many elements, both tangible and more subtle, that are relevant to the child. . . . Second, the child experiences his environment as a whole, while the statistical measures necessarily fragment it (4, p. 37).

Coleman went on to add that these statistical examinations of the differences in school environments for minority students tend to give impressions of less difference than actually exists, and that those impressions actually work to the disadvantage of minority students. Although "such an understatement of differences is a necessary consequence of a systematic statistical comparison" (4, p. 37), he saw this as a "lesser evil" than possible observer bias occurring from qualitative studies of school environments. However, Coleman admitted that in some circumstances qualitative study is necessary and pointed to the case studies in his report which revealed "aspects of segregation problems and community response that a statistical study could hardly match" (4, p. 37).
In discussing the implications for future educational research, Averch (1) recognized the gaps which exist in the understanding of the educational process. As one of the six major issues toward which he believed educational research should be directed, Averch pointed to "a merging of various research approaches" (1, p. 2). Those who support the qualitative method of research design would agree. Goetz (6) further elaborated the role of the qualitative researcher as being one which analyzes phenomena in naturally occurring settings and which emphasizes the interaction between empirical variables in those contexts. Credibility of the research is enhanced by examining all factors in an environment as opposed to the exclusivity of experimental research which deliberately eliminates variability by controlling extraneous factors. The eclectic approach to the collection of data allows the qualitative researcher to cross-check the correctness of data collected in other ways. This use of data gathered in different ways and from several sources is called triangulation.

Triangulation prevents the investigator from accepting too readily the validity of initial impressions; it enhances the scope, density, and clarity of constructs developed during the course of the investigation. It also assists in correcting biases that occur when the ethnographer is the only observer of the phenomenon under investigation (6, p. 11).

Averch (1) also pointed out that most educational research which examined student learning focused on "A
narrow range of cognitive skills" (l, p. 153). But higher cognitive and noncognitive achievements which are both important goals of education go untested. Therefore, he said "current research cannot lead to conclusive generalizations about educational outcomes, because it cannot measure most of them well" (l, p. 153). He went on to reiterate,

It will be necessary to merge the various research approaches. If economists want to fit educational "production functions," they will have to revamp the approach competely to include in their models specific process and organizational factors that affect students, as well as interaction effects. The failures of the input-output approach are, in fact, causing everyone to look more deeply at fundamental assumptions about education. And so the economists find themselves face to face with psychologists and educators, being forced into a detailed analysis of what goes on in schools and classrooms (l, p. 165).

The qualitative method is a way of approaching a "detailed analysis of what goes on in schools and classrooms." Patton (9) reviews four elements of collecting qualitative data.

First, the qualitative methodologist must get close enough to the people and situation being studied to be able to understand the depth and details of what goes on. Second, the qualitative methodologist must aim at capturing what actually takes place and what people actually say: the perceived facts. Third, qualitative data consist of a great deal of pure description of people, activities and interactions. Fourth, qualitative data consist of direct quotations from people, both what they speak and what they write down (9, p. 36).
Research studies relying solely on statistical analysis for conclusions have fallen short of definitive results linking school facilities and curricular programs to achievement. McPartland and Karweit (7) analyze the failure of research efforts to support the effectiveness of schools. Although much research points to the ineffectiveness of schools, they argue that these conclusions are misleading. They support the position that the reasons differences in schools account for so little of the variation in student achievement are because most statistical analyses have not met the scientific standards for controlled experiments. They also would agree with those who claim that many survey procedures have been insensitive to important educational factors. Furthermore, they support the position that the differences in students because of their backgrounds account for the most variation in student outcomes. Suggesting two ways to enlarge the scope of variations studies in school environments, McPartland and Karweit propose first to "select samples that maximize the range of variation on educational practices and environments" and second to "develop more sensitive measures that capture variation in educational environments existing in representative samples of schools and classrooms" (7, p. 373). The second approach assumes that previous research studies have not found large differences because "they overlooked important environmental
variation within the same schools or because they failed to measure the duration of exposure of different students to particular school factors" (7, p. 374). Another possibility is to measure the variation in performance over a period of time for a student population or to be more sensitive to changes in school programs over time rather than to measure achievement of a selected set of students for a specified program at a given time.

However, even sensitivity to various approaches will not yield desired results as long as students are not randomly distributed among selected schools, and no naturally occurring setting will yield the populations and the situations required for controlled experimental research. If advantaged students attend one school and disadvantaged another McPartland and Karweit suggest that no statistical trick can separate out the influence of the student's family background versus the type of school on student learning. Even if there is no relationship in a sample between school attended and important family background measures such as socioeconomic status, there can be no assurance that some other unmeasured background condition (such as family ambition or student personality) has not contributed to a nonrandom self-selection or assignment of students to schools (7, p. 377).

Concluding that methodological questions about research on school effectiveness has given rise to new directions in research, McPartland and Karweit concede that "statistical techniques alone do not hold the key to clearer
understanding of questions concerning the effectiveness of schools. . . . and methodological work is helping to develop new ways of thinking about those effects that may open up fresh directions for theory and research worthy of serious attention" (7, pp. 382-3).

Bogdan suggests that research itself does not necessarily have to be a uniquely scientific enterprise. Rather, it can be practical and include common sense understanding. He criticizes educational researchers for modeling research efforts after what some refer to as hard science, pointing out that researchers in the sciences such as physics and chemistry do not define science as narrowly as those who try to imitate them. He claims that part of the scientific attitude is to be open-minded concerning method and evidence. Qualitative research "involves rigorous and systematic empirical inquiry which is data-based" (2, p. 39). He goes on to add that "the researcher's primary goal is to add to knowledge not to pass judgement on a setting. The worth of a study is the degree to which it generates theory, description, or understanding" (2, p. 42).

Procedures

This study was conducted using the case study approach in each of two school districts in Texas. The primary goal of the study was to look for achievement trends over a
several year period and to compare these trends to the corresponding costs for program implementation and maintenance. The use of computers for classroom instruction was selected as the program because the technology was new and not widely used prior to a few years ago. Consequently, an opportunity presented itself to study achievement and program costs over a multi-year period in a situation where the program was not in place for a few years and then a fresh approach was implemented at a relatively high cost. Averch (1), who found no significant relationship between school inputs or resources and student achievement, commented on his review of the studies to that date, "the studies do not show what would happen if the educational system received a massive increase or decrease in resources" (1, p. 148). This study provided precisely that opportunity, to examine the effects of a massive increase of a particular resource on a specific student outcome. Not only Averch but also Fowler (5) pointed out the value of longitudinal studies. Averch noted, "we must begin to examine educational outcomes over time and on many dimensions" (1, p. xiii). It was McPartland (7) who in discussing the failure of traditional methods to find a significant relationship between school resources and student achievement, called for more sensitive measures to be employed.
These case studies have brought together those characteristics which were called for by previous researchers: a massive increase of a resource, a study over time, a more sensitive measure, and a study over many dimensions. The qualitative case study approach provided the vehicle for this opportunity. Patton pointed out, "The failure to find statistically significant differences in comparing people on some outcome measure does not mean that there are not important differences among those people on those outcomes. The differences may simply be qualitative rather than quantitative" (9, p. 74). Averch also noted that student outcomes are both cognitive and noncognitive, and those noncognitive factors even though elusive and difficult to quantify are very important because they include "such vague but important concepts as happiness and quality of life" (1, p. 16).

Even though the primary goal of these case studies was to focus on cognitive achievement and its related costs, a byproduct of the case study approach was the opportunity to study the resulting noncognitive outcomes of the programs. This was accomplished through the use of questions, observations, and descriptions. Patton elaborated:

To fully grasp the meaning of change in life for particular clients and persons it is necessary to develop a description of life quality which allows the interdependent parts of quality to be integrated into a whole. Quality has to do with
nuance, with detail, with the subtle and unique things that make a difference beyond the points on a standardized scale. Quality is what separates and falls between those points on a standardized scale. . . . This is not a question of interval versus ordinal scaling, but one of meanings. What do programs mean to participants? What is the quality of their experience? Answers to such questions require detailed, in-depth, and holistic descriptions that represent people in their own terms and that get close enough to the situation being studied to understand firsthand the nuances of quality (9, p. 74).

This naturalistic research strategy described by Goetz as observation "used to acquire firsthand, sensory accounts of phenomena as they occur in real world settings" where "investigators take care to avoid purposive manipulation of variables in the study" (6, p. 3) made use of a number of data gathering techniques. Although the primary and most time consuming was the formal interview using focused interview schedules, other techniques such as collection of documents, observations, field notes, and photographing various settings provided the capacity for the triangulation of results. Triangulation is the use of data gathered in different ways and from several sources. Patton stresses triangulation as a means of reconciling qualitative and quantitative data. It is important because of its potential to verify and validate qualitative analysis. He lists two kinds of triangulation. The first provides for "checking out the consistency of findings generated by different data
collection methods" (9, p. 329). Different data collection methods include observations, interviews, and document analyses. Each method is a limited source of data and potentially weak when used as a single source. However, a multi-method approach strengthens and increases both the validity and the reliability of the evaluation of data (9, p. 157). The second type of triangulation allows for "checking out the consistency of different data sources within the same method" (9, p. 329). This could include comparisons of what an individual reports in a private interview to what they say in a public meeting or comparisons of what people with different points of view have to say with regard to the same question. Figure 1 is an illustration of the flowchart of procedures followed in this study. Goetz also suggests that the researcher use various types of data collection techniques so that "data collected in one way can be used to cross-check the accuracy of data gathered in another way" (6, p. 11). Triangulation prevents the tendency possible in qualitative research of accepting conclusions too soon. It provides the basis for broader and more profound understanding as well as for the development of clearer constructs.
Fig. 1.--Flowchart of Procedures
Subjects

The subjects for this study were two school districts in Texas, one located in north Texas and the other in west Texas. Having an enrollment of approximately thirty-five thousand, the north Texas district is a suburban district located in a large metropolitan area, whereas the west Texas district with an enrollment of about twenty-five thousand is a county district located in a relatively sparsely populated area. The districts were selected for the study based on the following criteria:

1. The district is located in Texas.
2. The organization of the district includes junior high schools with grades seven, eight, and nine.
3. The school district administers achievement tests to students at selected grade levels.
4. The school district uses Bulletin 679 to account for expenditures in such a way as to be able to use the general ledger together with budget documents to identify the costs for computer equipment, software, and related costs for each junior high school campus.
5. The school district is one of the twenty-five largest school districts in the state.
6. The school district uses micro or mini-computers for classroom instruction.
7. The school district would make available to the researcher the needed accounting and achievement information.

8. Permission could be obtained from the superintendent of the district to conduct the study in the district.

The Texas School Directory (11) narrowed the list of the twenty-five largest school districts to seven school districts which conformed to criteria 1, 2, and 5. Telephone calls to individuals in the school districts further limited the list to three school districts. Of the four school districts eliminated, three of them did not use computers for classroom instruction at the junior high school level, and the fourth school district had not been consistent in its testing program for the last seven years. Of the three school districts conforming to criteria 1, 2, 3, 4, and 5, one declined to release school district data and grant permission to the researcher to conduct the study in the district. Consequently, two school districts were available for the study.

Data Collection

The case study approach to this research project was implemented using a variety of data collection techniques including observations of computer labs in fourteen junior high schools, taped interviews with forty-three principals,
teachers, and students; nine individual visits with central office staff members; and collection of a number of different types of documents. The taped interviews were accomplished using a focused interview schedule with four component parts, one each designed for the curriculum coordinators, the building principals, the teachers, and the students to be interviewed in each school district. (See Appendices A, B, C, and D.) Each of these groups of individuals was selected for interviewing not only to gain multifarious perspectives of the program but also to cross-check the validity of information gained at each level and from each individual. The parts of the in-depth interview schedule were designed not only with the research questions in mind but also with the thought and purpose of discovering characteristics of the programs and perceptions of the participants which were not anticipated in advance of the field work. Bogdan suggested that although the research design should be "an evolving process, one in which the questions to be asked and the data to be collected emerge in the process of doing research" (2, p. 71), there are times when interview and observational schedules are essential. They are particularly useful in multi-subject or multi-site studies for which the researcher is most concerned about gathering comparable data across sites.
To overcome the undesirable potential of having more concern with following the schedule than with hearing the responses and with picking up on nuances which would lead to more probing questions, the researcher was careful to be fully familiar with the questions on the parts of the schedule prior to the interviews. This provided the flexibility of the order in which the questions were asked and provided for a better and more comfortable flow in the conversation. Bogdan defines the interview as "a purposeful conversation, usually between two people that is directed by one in order to get information. In the hands of the qualitative researcher, the interview takes on a shape of its own" (2, p. 135). Bogdan goes on to say that regardless of whether the interview is the primary data gathering technique or is used in conjunction with other means such as observation or document analysis, it is used to gather descriptive data in the subjects own point of view and in their own words in order to better understand a particular person or situation.

In the west Texas district the director of secondary instruction arranged the school visits with each of the six junior high school principals and also introduced the researcher to various central office staff members from whom information would be gathered. Each building principal selected the teacher and in some cases the student to be
interviewed. At some schools the teacher selected the student. During the visit to this school district formal, taped interviews were obtained from six principals, six teachers, six students, and the district coordinator for instructional computing.

In the north Texas district the researcher arranged all the school visits with each building principal and with district staff personnel. As in the west Texas district the principal selected the teacher to be interviewed and in most cases the teacher selected the student to be interviewed. Again, formal, taped interviews were obtained using the same set of interview schedules with eight principals, eight teachers, and eight students.

In addition to these formal interviews, informal visits were held with various central office staff personnel. In the west Texas district the director of secondary instruction, the director of planning, evaluation, research, and testing, the coordinator of public information, the director of food service, and the director of student services were consulted. In the north Texas district individual meetings were held with the director of instructional computing, the administrative assistant for secondary instruction, the director of food service, and the assistant superintendent for business. Not only were notes taken during these visits but also documents containing such information as curriculum
guides, sample instructional materials, test scores, budget forms, copies of general ledgers, cost figures, enrollment data, and numbers of students participating in the free and reduced price lunch programs. The Chamber of Commerce in each city where the districts are located furnished various demographic information. Field notes and photographs were also taken during visits to the computer labs in each school. Attendance at school board meetings in each of the districts during which notes were taken and documents collected provided further insight into the attitudes, feelings, and general level of support of the computer instructional programs held by the governing bodies in each district.

The study was conducted during a three-month period in the spring and summer of 1985. Formal permission from the superintendent of each district was obtained after submission of a letter outlining the research project, and detailing the information which would be needed, and the personnel who would be interviewed. In one district the researcher established the dates and times for the school visits, and in the other district the director of secondary instruction made these arrangements with the school principals.

In almost all cases the interviews took place in quiet rooms such as the principal's office, department offices, or
classrooms not being used for other purposes at that time. This provided environments free from interruptions and distractions and the opportunity for both the interviewer and the subject to feel more comfortable. The one exception to this occurred at a school where both the principal and the teacher insisted that the teacher interview take place in the classroom while students were working at their computer terminals. Interviews with the students (there were three in this case) also took place in this same setting. In most cases the interviews evolved as interesting visits between two individuals with a common interest. The exception to this was some of the interviews with students. Although most were open with their responses and proud to have been selected as the one student to represent his school in the study, a few were apprehensive and nervous about the meeting. When it was obvious that this was the case, the interviewer took time and special care to review with the student the purpose of the interview and its subsequent uses.

The interview schedules were followed closely except in some cases where the nature of the questions seemed inappropriate in the given situation or for the individual being interviewed. In many interviews the subjects volunteered answers to questions on the schedule before the question was asked. Although the schedules were closely
followed, the interviews were not limited to the questions on the schedules. Many times pertinent topics emerged naturally and were pursued in order for the researcher to gain deeper understanding and insight. In view of the fact that both principals and teachers were asked questions about a program which had been in progress for several years, inconsistency of answers sometimes occurred. When this happened, individuals were asked to confirm or clarify the other's response in order to bring a point of discrepancy into agreement. This provided a cross-check of reliability. An example of such a question to a principal might have been, "Mrs. Jones tells me the CAI program was first used for ninth grade students three years ago. Is that the way you remember it?" Responses to these types of questions were also referred to the district coordinator who was asked to check records in some cases. This procedure was also followed after all information was collected, tapes had been transcribed, and numerical data were charted, i.e., district personnel were called on the telephone to clear up ambiguities and discrepancies.

Data Analysis

The data were analyzed according to the procedures delineated by Miles (8). According to him data analysis has three component parts: data reduction, data displays, and
conclusion drawing and verification. In addition to elaboration of field notes and verification of various numerical data which was collected, all taped interviews were transcribed verbatim. All of this composed a body of handwritten notes and both handwritten and typed transcriptions totaling over four hundred thirty pages. An example of several pages of a transcription can be found in Appendix E. "Data reduction is a form of analysis that sharpens, sorts, focuses, discards, and organizes data in such a way that final conclusions can be drawn and verified" (8, p. 21). The data reduction phase of the analysis consisted of categorizing this collection of notes and transcriptions according to a list of codes. The list was initially compiled to accommodate the research questions but was later enlarged after a first reading of the notes and transcriptions. Bogdan suggests that while reading through the data "certain words, phrases, patterns of behavior, subjects' ways of thinking, and events repeat and stand out" (2, p. 156). By searching through the data for regularities and patterns and by taking note of research topics, coding categories emerge. The use of the coding categories provides a means of sorting descriptive data "so that the material bearing on a given topic can be physically separated from the other data" (2, p. 156). Following Miles (8) recommendations codes were devised to prompt the
researcher's memory regarding obvious categorizations. Thus, the code TP was used for Teacher Preparation, ACH for student achievement, and PA for parent attitude as examples. The final elaborated list of codes consisted of twenty-five items. A list of these can be seen in Appendix F. In addition to the codes which were written in the margins of the transcriptions, notes for future reference were also written during the many readings. These marginal remarks were the impromptu results of ideas which the researcher wanted to retain for future use. As Patton suggested, during the coding "ideas and the reactions to the meaning" surfaced and suggested "new interpretations, leads, and connections with other parts of the data." All this pointed toward the analytic work and led "further and further into analysis" (9, p. 65).

The second phase of the data analysis was the data display aspect. Data were displayed using a combination of narrative text, matrices, graphs, and charts. Each of these displays was designed not only to focus on the research questions but also other mediating factors which the original set of research questions did not address. One of these, for example, was a problem described by many people in the west Texas district and which some of them labeled "burn out" with the program.
All of the numerical data gathered in each district was displayed using charts and graphs. This included such data as expenditures, achievement scores, types of computer equipment, implementation schedules, and data reflecting the percentage of students participating in the free and reduced price lunch program, which was used as one of the measures of socioeconomic status. Much of the information gathered from the coded transcripts was displayed in narrative text. To further consolidate and condense these data, matrices of coded factors were used which displayed characteristics which seemed to be consistent from school to school or which appeared to have a marked bearing upon the extremes of expenditure and achievement. Each of these matrices was conceptually analyzed for interesting patterns which emerged. Patterns occurring in one matrix were compared to patterns which occurred in other matrices. Extensive description of these emerging patterns was used to point to ultimate themes. Examples from the interviews and from observations were also used to further clarify, interpret and conceptualize the influence which the multiple variables exhibited.

The last phase of the data analysis was the conclusion drawing and verification stage. Goetz (6) suggested there are five strategies for general analytic procedures used by the qualitative researcher. These are analytic induction,
constant comparison, typological analysis, enumeration, and standardized observational protocols. The two which seemed most appropriate for this study were analytic induction and constant comparison. Typological analysis involves partitioning every observation into categories "on the basis of some canon for disaggregating a whole phenomenon" (6, p. 183) and is used more for describing observed behaviors than for analyzing data collected from interviews. A researcher might, for example, use some theorist's classification of different types of behaviors, then apply them to a research setting taking note of occasions when student behaviors on a playground or in a classroom would fall into those prearranged categories. Conclusions or generalizations would then emerge from this technique of data analysis. The same would be true for the use of standardized observational protocols such as the Flanders Interaction Analysis System. Under this system a researcher might use the observation data collection mode, sitting in a classroom tallying behavioral occurrences on some selected time interval. Observational protocol is closely associated with enumeration which uses frequency counts requiring "a precise identification of phenomena or categories of phenomena and a consistency in data collection techniques" (6, p. 184).

However, analytic induction and constant comparison are both more flexible and compatible with each other. Patton
(9) says that analytic induction or "inductive analysis" as he calls it

means that patterns, themes, and categories of analysis come from the data; they emerge out of the data rather than being imposed on them prior to data collection and analysis. The analyst looks for natural variation in the data. For evaluators, the study of natural variation will involve particular attention to variation in program processes and how participants respond to and are affected by programs" (9, p. 306).

Analytic induction involves scanning data, such as transcribed interviews, searching for categories of occurrences, and relationships among categories. These findings may be developed into hypotheses supported by initial cases but modified by the examination of subsequent cases. Like analytic induction, constant comparison requires no particular unit of analysis. Frequently regarded as a supplement to analytic induction, the constant comparison method

combines inductive category coding with a simultaneous comparison of all social incidents observed. As social phenomena are recorded and classified, they are also compared across categories. Thus, the discovery of relationships, or hypothesis generation, begins with the analysis of initial observations, undergoes continuous refinement throughout the data collection and analysis process, and continuously feeds back into the process of category coding. As events are constantly compared with previous events, new typological dimensions as well as new relationships may be discovered (6, p. 182).
Summary

Qualitative research in the field of educational inquiry is emerging as a valid mode which fills in many of the gaps left by quantitative methods. By expanding the potential for gathering pertinent data in the natural setting where students and teachers are working and interacting, researchers have the opportunity for broadening the base of understanding and for linking school characteristics which quantitative studies have failed to do. Experimental studies by the very nature of design limit the scope of data which can be considered. By the use of the qualitative case study approach to studying the relationship between expenditures for computers and achievement in mathematics, this investigation was expanded to include not only the numerical measures of achievement but also higher cognitive and noncognitive indications of achievement and attitudes of students working with computers. It also discovered other mediating factors which influence these two elusive extremes.
CHAPTER BIBLIOGRAPHY


2. Bogdan, Robert C. and Sari Knopp Biklen, Qualitative Research for Education An Introduction to Theory and Methods, Boston, Massachusetts, Allyn and Bacon, 1982.


CHAPTER IV

CASE NARRATIVES

The data collected was from two school districts in Texas, one located in west Texas and the other in north Texas. The 1984-85 Texas School Directory (4) listed the former with a 1983-84 membership of 25,388 making it the twenty-second largest district in Texas with two high schools, six junior high schools, and twenty-five elementary schools. The latter with a membership of 35,032 students and a ranking of twelfth largest school district in the state had four high schools, nine junior high schools, and thirty one elementary schools. Both school districts had additional facilities which serve special student populations. As the only school district in the county, the west Texas district served a population that is scattered over approximately nine hundred square miles. The north Texas district on the other hand was a suburban district in a metropolitan area serving a denser population living in a ninety-four square mile area.

Located in the oil-rich Permian Basin, the west Texas district had an appraised valuation of $5,798,283,000 with a total tax rate of 0.775 per $100 valuation, the primary
industry in the district being focused on the exploration, drilling, and recovery of oil and natural gas. The predominately protestant population was 64 per cent white, 4.5 per cent black, 21.5 per cent Hispanic, and 10 per cent other in distribution. The median family income from the 1980 census was $18,764 and the unemployment rate as of January, 1985, was 5.6 per cent.

Located in a large metropolitan area, the north Texas school district had an appraised valuation of $4,993,978,000 with a total tax rate of 0.966 per $100 valuation. The appraised valuation and tax rates for both school districts were taken from the 1983-84 official budget, and these figures were listed in the Texas School Directory (4) published by the Texas Education Agency in October, 1984. The predominately protestant population was 93 per cent white, 3 per cent black, and 4 per cent Hispanic in distribution. The median family income from the 1980 census was $27,410, and the unemployment rate as of 1984 was 3.6 per cent. A fast growing community of over two hundred thousand, 62 per cent had lived in the city for less than five years. Fifty-one per cent had attended or graduated from college.
THE WEST TEXAS SCHOOL DISTRICT

Computer Equipment, Software, and Related Costs

The West Texas school district had six junior high schools all of which were used in this study. They were designated by the capital letters A, B, C, D, E, and F. This school district began using computers for instruction 1974 when it acquired through a rental agreement (but later purchased) a mini-computer and two, thirty-two terminal labs from Computer Curriculum Corporation which also furnished all curriculum materials and software for the instructional program. It was a computer-assisted instruction program focusing on mathematics, reading, and language arts skills for students who were behind in grade level achievement. Funded by Title I of the Elementary and Secondary Education Act, it was a pull-out program for students at one junior high and one high school. The program continued to operate in the same manner until 1982 when the federal court ordered that both of these schools, which had predominantly black student bodies be closed, and bussing for racial balance was implemented in the district. In the 1982-83 school year, the high school was reopened as a junior high, and the junior high was reopened as a magnet elementary school.

The computer-assisted instructional program designed and published by Computer Curriculum Corporation was a
computer-driven drill and practice program allowing individual students to interact with the instructional program through an individual computer terminal. The classes were scheduled with a maximum of sixteen students per class resulting in a one-to-one correspondence between students and computer terminals. In mathematics the two software programs used most extensively were "Math Skills, Grades 1-7" and "Problem Solving, Grades 3-6." Each of these programs were divided into strands. For Math Skills the strands were Addition, Number Concepts, U. S. Measurement, Subtraction, Equations, Applications, Metric Measurement, Multiplication, Problem Solving, Division, Fractions, and Decimals. For Problem Solving the strands were How Many; Money; Mystery Numbers and Age; Measure; Number Systems; Time, Rate and Distance; and Geometry. In addition to these primarily used software programs there were others such as "Mathematics Strands, Grades 7 & 8," "Math Enrichment Modules, Grades 7 & 8," "Introduction to Algebra," "Introduction to Programming with CCC BASIC," and "Math Skills" from which the teacher could choose for individual students or for special occasions. Since the district has mainly rented the computer equipment and the software, it has been able to keep the most up-to-date versions of both for no additional costs to the district.
Sometime prior to 1982 the school district exercised an option with Computer Curriculum Corporation and purchased the mini-computer and sixty-four terminals which it had been renting. The total cost to the district for renting additional equipment, renting software for all the equipment, and paying for maintenance on all equipment both owned and rented was $515,685. Elaboration and explanation of this expenditure is shown in Table I and the notes for Table I.
<table>
<thead>
<tr>
<th></th>
<th>1982-83</th>
<th>1983-84</th>
<th>1984-85</th>
<th>School Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>16 Term. 9th Grade</td>
<td>$12,782</td>
<td>16 Term. 9th Grade</td>
<td>$12,782</td>
</tr>
<tr>
<td></td>
<td>Remote Math &amp; Lab</td>
<td></td>
<td>Remote Math &amp; Lab</td>
<td>$12,782</td>
</tr>
<tr>
<td></td>
<td>9th Grade Math &amp; English</td>
<td></td>
<td>2 TRS 80's Science &amp; $1,500 Homemaking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See Note 1.</td>
<td>$14,000</td>
<td>See Note 2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16 Term. 9th Grade</td>
<td>$14,807</td>
<td>16 Term. 9th Grade</td>
<td>$12,782</td>
</tr>
<tr>
<td></td>
<td>Remote Math &amp; Lab</td>
<td></td>
<td>Remote Math &amp; Lab</td>
<td>$12,782</td>
</tr>
<tr>
<td></td>
<td>9th Grade Math &amp; English</td>
<td></td>
<td>2 TRS 80's Math</td>
<td>$14,000</td>
</tr>
<tr>
<td></td>
<td>See Note 7.</td>
<td></td>
<td>See Note 3.</td>
<td></td>
</tr>
<tr>
<td>School D</td>
<td>16 Term. 9th Grade</td>
<td>$30,687</td>
<td>16 Term. 9th Grade</td>
<td>$37,315</td>
</tr>
<tr>
<td></td>
<td>Remote Math &amp; Lab</td>
<td></td>
<td>Remote Math &amp; Lab</td>
<td>$37,315</td>
</tr>
<tr>
<td></td>
<td>9th Grade Math &amp; English</td>
<td></td>
<td>1 TRS 80 History</td>
<td>$1,700</td>
</tr>
<tr>
<td></td>
<td>See Note 7.</td>
<td></td>
<td>1 TRS 80 Math</td>
<td>$1,700</td>
</tr>
<tr>
<td>School E</td>
<td>16 Term. 9th Grade</td>
<td>$30,687</td>
<td>16 Term. 9th Grade</td>
<td>$37,315</td>
</tr>
<tr>
<td></td>
<td>Remote Math &amp; Lab</td>
<td></td>
<td>Remote Math &amp; Lab</td>
<td>$37,315</td>
</tr>
<tr>
<td></td>
<td>9th Grade Math &amp; English</td>
<td></td>
<td>2 TRS 80's Science &amp; $3,400 Social Studies</td>
<td></td>
</tr>
<tr>
<td>School F</td>
<td>16 Term. 9th Grade</td>
<td>$30,687</td>
<td>16 Term. 9th Grade</td>
<td>$37,315</td>
</tr>
<tr>
<td></td>
<td>Remote Math &amp; Lab</td>
<td></td>
<td>Remote Math &amp; Lab</td>
<td>$37,315</td>
</tr>
<tr>
<td></td>
<td>9th Grade Math &amp; English</td>
<td></td>
<td>6 Applies Science &amp; $8,000 Foreign Language</td>
<td></td>
</tr>
</tbody>
</table>
| Totals where equipment is used for mathematics | $164,377 | $176,524 | $174,824 | $515,685
Notes for Table I

Note 1.--The school year 1982-83 was the first year that School A was used for a junior high school. In prior years it had been a high school at which the mini-computer with a thirty-two terminal lab had been in operation. When it opened as a junior high, sixteen of the terminals were moved to another location leaving a sixteen terminal lab at School A. Costs for School A for 1982-83 were:

16 Terminal Remote Lab

<table>
<thead>
<tr>
<th></th>
<th>Rental</th>
<th>Maintenance</th>
<th>Curriculum</th>
<th>Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ 0</td>
<td>$6,344</td>
<td>$3,200</td>
<td>$0</td>
</tr>
</tbody>
</table>

Mini-Computer

<table>
<thead>
<tr>
<th></th>
<th>Rental</th>
<th>Maintenance</th>
<th>Curriculum</th>
<th>Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0</td>
<td>$1,921</td>
<td>$533</td>
<td>$0</td>
</tr>
</tbody>
</table>

Telephone Supplies

<table>
<thead>
<tr>
<th>Telephone Supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>$684</td>
</tr>
<tr>
<td>$100</td>
</tr>
</tbody>
</table>

Cost for School A in 1982-83 $12,782

Use: Academic Skills in English and Math in Grade 9

Note 2.--The school year 1982-83 was the installation year for School B; but since the district already owned the equipment, it was installed at the beginning of the school year and annual costs were paid at 100 per cent. Costs for School B were:

16 Terminal Remote Lab

<table>
<thead>
<tr>
<th></th>
<th>Rental</th>
<th>Maintenance</th>
<th>Curriculum</th>
<th>Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ 0</td>
<td>$6,344</td>
<td>$3,200</td>
<td>$2,025</td>
</tr>
</tbody>
</table>
Mini-Computer
   Rental  0
   Maintenance  1,921
   Curriculum  533
   Installation  0
   Telephone - dedicated data line (12 months)  684
   Supplies  100

   Cost for School B in 1982-83  $14,807

Use: Academic Skills in Math and English in Grade 9.

Note 3.--The school year 1982-83 was the installation year for Schools C, D, E, and F. Although the classes were scheduled with students and teachers assigned when school started in September, the equipment was not all in place and operating until later in the school year, ranging from November to January in various schools. Costs were prorated for the year based on nine-twelfths of the annual costs. They were:

   16 Terminal Remote Lab
   Rental  $14,098
   Maintenance  4,758
   Curriculum  2,400
   Installation  2,025

   Mini-Computer
   Rental  4,302
   Maintenance  1,441
   Curriculum  400
   Installation  650
   Telephone - dedicated data line (nine months)  513
   Supplies  100

   Cost/school for 1982-83  $30,687

Use: Academic Skills in English & Math in Grade 9.
Note 4.—Schools A and B used the mini-computer located at School A. The terminals and the computer were owned by the district. The 1983-84 costs for each of these schools were:

<table>
<thead>
<tr>
<th>Service</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Terminal Remote Lab</td>
<td>$</td>
</tr>
<tr>
<td>Rental</td>
<td>0</td>
</tr>
<tr>
<td>Maintenance</td>
<td>6,344</td>
</tr>
<tr>
<td>Curriculum</td>
<td>3,200</td>
</tr>
<tr>
<td>Installation</td>
<td>0</td>
</tr>
<tr>
<td>Mini-Computer</td>
<td></td>
</tr>
<tr>
<td>Rental</td>
<td>0</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1,921</td>
</tr>
<tr>
<td>Curriculum</td>
<td>533</td>
</tr>
<tr>
<td>Installation</td>
<td>0</td>
</tr>
<tr>
<td>Telephone - dedicated data line</td>
<td>684</td>
</tr>
<tr>
<td>Supplies</td>
<td>100</td>
</tr>
<tr>
<td>Cost/school for 1983-84</td>
<td>$12,782</td>
</tr>
</tbody>
</table>

Use: Academic Skills in Math and English in Grade 9.

Note 5.—In the 1983-84 school year schools C, D, E, and F used the mini-computer located at a high school. The system was rented. After three years of renting the district would have an option to purchase the equipment for the balance of the rental/purchase agreement. The 1983-84 costs for each of these schools were:

<table>
<thead>
<tr>
<th>Service</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Terminal Remote Lab</td>
<td></td>
</tr>
<tr>
<td>Rental</td>
<td>$18,797</td>
</tr>
<tr>
<td>Maintenance</td>
<td>6,344</td>
</tr>
<tr>
<td>Curriculum</td>
<td>3,200</td>
</tr>
<tr>
<td>Installation</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Mini-Computer Rental</td>
<td>5,736</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1,921</td>
</tr>
<tr>
<td>Curriculum</td>
<td>533</td>
</tr>
<tr>
<td>Installation</td>
<td>0</td>
</tr>
<tr>
<td>Telephone - dedicated data line (for 12 months)</td>
<td>684</td>
</tr>
<tr>
<td>Supplies</td>
<td>100</td>
</tr>
<tr>
<td><strong>Cost/school for 1984-85</strong></td>
<td><strong>$37,315</strong></td>
</tr>
</tbody>
</table>

Use: Academic Skills in Math and English in Grade 9.

**Note 6.**—The costs for the 1984-85 school year were identical to those in 1983-84 for the Academic Skills program.

Use: Academic Skills in Math and English in Grade 7.

**Note 7.**—School B had nine TRS 80's acquired in the 1982-83 school year. The principal said they are used for a club activity for eighth and ninth grade students who wanted to come in before or after school or at lunch. They were located in a seventh grade math room, and the teacher used them as extra, supplementary, or motivation for seventh grade math.
Objectives of Computer Instruction

As a part of its court-ordered desegregation plan, the district moved sixteen of the terminals to one junior high school, kept the mini-computer and sixteen terminals at the newly converted junior high school, rented sixty-four more terminals, sixteen for each of the other four junior high schools in the district, and rented another mini-computer which it housed in a high school. Using the four newly acquired sixteen terminal remote labs and the two sixteen terminal remote labs already owned by the district to communicate with the newly acquired mini-computer located at a high school and the mini-computer located at the recently converted junior high school, the school district implemented a program called Academic Skills in each of the six junior high schools in the district. Communication with the mini-computers was accomplished via telephone modems using dedicated data lines from the remote labs to the computers.

As in the older Title I program, Academic Skills was also designed to help students who were behind in grade level achievement but only in mathematics and language arts. Under the new format reading was not to be specifically addressed in Academic Skills because there were also reading labs in each junior high school. (Computers would not be used in these labs.) Also under the new plan the students would not be pulled out of their regular classes for supplementary instruction but, on the contrary, would be scheduled
in the Academic Skills class as a replacement for either their mathematics class or their English class or for both if they were two or more years behind in achievement in either mathematics or English or both. Grade level achievement would be measured by their scores on the Metropolitan Achievement test administered in the prior year. As a part of the district's desegregation plan, the courses were designed to help bring students up to grade level who had fallen behind in achievement because of displacement, desegregation, or just lack of skills. In the 1982-83 and the 1983-84 school years the targeted population was ninth grade students. But in the 1984-85 school year the program has been designated almost exclusively for seventh grade students, the rationale being that remediation at this grade level would better serve the total instructional program of the students.

Student Access to Computers

The classroom activity for each student was consistent districtwide although the principal of each school determined the scheduling of the labs according to the needs of the school. During each class period the teacher conducted a thirty-minute group instructional block during which time the essential elements of the specified curriculum were taught by the teacher to the students as a group. Teaching
materials for this phase consisted of textbooks, CCC worksheets, or teacher prepared worksheets. The second phase consisted of individual student interaction with the computer via a computer terminal. Each student completed two, ten-minute computer-assisted instruction lessons which had been selected to reinforce the skills of each student on their own individual level of achievement. This was done in one of two ways. The teacher determined the student's level and assigned the lesson, or the student could begin with an introductory phase in which the computer determined each student's level after one hundred minutes or ten, ten-minute lessons on the computer. Although both activities took place during each fifty-five minute class period, the order in which the activities occurred was not prescribed by district guidelines but was left to the discretion of the teacher and the building principal.

It was this flexibility at the school level which allowed the principal autonomy in the scheduling of each lab. Some principals scheduled a teacher and sixteen students to the room in which the computer terminals were located for the full fifty-five minute period. Under this plan the computer terminals were not in use during the group instruction part of the class period. Other principals, however, chose to have students move at the middle of the class period resulting in maximum usage of the computer
terminals, i.e., the group instruction took place in another room, and the room in which the computer terminals were located was used only for the computer interaction part of the class period. Table II shows how each of the six schools made use of this option in scheduling. Since this was an evolving program and information was collected in interviews with teachers and principals, the data presented in Table II is most reflective of the 1984-85 school year.

**TABLE II**

STUDENT ACCESS TO COMPUTERS IN THE WEST TEXAS DISTRICT

<table>
<thead>
<tr>
<th>School</th>
<th>Number of Groups Scheduled in Lab Each Period</th>
<th>Maximum Number of Students Served Each Class Period</th>
<th>Maximum Number of Students Having Access to the Lab Each Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>2</td>
<td>32</td>
<td>128 See Note 1</td>
</tr>
<tr>
<td>School B</td>
<td>2</td>
<td>32</td>
<td>192 See Note 2</td>
</tr>
<tr>
<td>School C</td>
<td>1</td>
<td>16</td>
<td>80 See Note 3</td>
</tr>
<tr>
<td>School D</td>
<td>1</td>
<td>16</td>
<td>96 See Note 4</td>
</tr>
<tr>
<td>School E</td>
<td>2</td>
<td>32</td>
<td>192 See Note 5</td>
</tr>
<tr>
<td>School F</td>
<td>1</td>
<td>16</td>
<td>96 See Note 6</td>
</tr>
</tbody>
</table>

School G will designate the junior high school which was closed in 1982 as a result of the desegregation order.
Notes for Table II

Note 1.—One English teacher had four classes using the lab and one mathematics teacher had four classes each of which used the lab. This means that during some class periods both teachers and both classes of students were in the lab at one time, one teacher providing group instruction to sixteen students and the other sixteen students working at the computer terminals. The principal estimated that at one time or another during the school year about one hundred fifty students had access to the CAI Academic Skills class.

Note 2.—The principal of this school gave priority to seventh and eighth grade English and then seventh and eighth grade mathematics in that order. (Seventh grade got first priority and then eighth grade in both subject areas.) There were actually eleven groups of students scheduled during the day, leaving one half of one period free for optional use. A special education teacher frequently used this option. During each day a maximum of one hundred ninety-two students had access to the lab.

Note 3.—One teacher who had three mathematics classes and two English classes was scheduled in the lab five periods each day. Another teacher used the lab one period a week with her enriched seventh grade math class. Also, a special education teacher used the lab occasionally on an
optional basis. However, there were eighty students each
day who were scheduled to use the lab on a regular basis.

**Note 4.**—There were three teachers assigned to classes
of Academic Skills, two teachers each had one English class
and one teacher had one English and three mathematics
classes. The lab was used six periods a day by one class
each period. Priority was given to seventh grade students,
but after all seventh grade students who needed the program
were scheduled each period, the classes were filled to a
limit of sixteen students each with eighth graders. The
principal estimated that seventy-five to eighty of the
ninety-six students scheduled per day were seventh grade
students.

**Note 5.**—The principal had scheduled six sections of
mathematics and six sections of English to use the CAI lab
each day. These classes were taught by a total of six
teachers. By scheduling two sections each period of the
day, the principal believed that all seventh grade students
who needed the program had access to it. No eighth grade
students used the lab at this school.

**Note 6.**—There were two teachers assigned to Academic
Skills, one taught three English classes and the other
taught three mathematics classes. All the students were
seventh graders. Out of three hundred thirty seventh grade
students forty-eight of them had Academic Skills/English,
and forty-eight of them had Academic Skills/Mathematics. There were some students who had both classes.

Table III shows the number of students in average daily attendance in the junior high schools in the west Texas school district for the 1984-85 school year. Table IV shows the approximate percentages of students who had access to the computer-assisted instructional in the 1984-85 school year.

**TABLE III**

AVERAGE DAILY ATTENDANCE* IN THE WEST TEXAS SCHOOL DISTRICT

<table>
<thead>
<tr>
<th>School Year</th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
<th>School D</th>
<th>School E</th>
<th>School F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Gr</td>
<td>389</td>
<td>374</td>
<td>293</td>
<td>391</td>
<td>339</td>
<td>318</td>
</tr>
<tr>
<td>9th Gr</td>
<td>302</td>
<td>297</td>
<td>213</td>
<td>324</td>
<td>245</td>
<td>316</td>
</tr>
</tbody>
</table>

*Figures rounded to the nearest whole number.

**TABLE IV**

APPROXIMATE PERCENTAGES OF STUDENTS HAVING ACCESS TO THE COMPUTER-ASSISTED INSTRUCTIONAL ACADEMIC SKILLS CLASSES IN THE WEST TEXAS DISTRICT

<table>
<thead>
<tr>
<th>School Year</th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
<th>School D</th>
<th>School E</th>
<th>School F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Gr</td>
<td>33</td>
<td>51</td>
<td>27</td>
<td>25</td>
<td>57</td>
<td>30</td>
</tr>
</tbody>
</table>
Teacher Preparation

The notes for Table II reveal that a number of teachers in the district were assigned to teach the Academic Skills classes. There were never fewer than two teachers assigned to use the computer labs, and one principal indicated that six different teachers used the computer lab each day. Interviews with the principals also indicated that the turnover of teachers from year to year was high for this particular program. The district coordinator estimated the turnover to be about thirty-three per cent. Many of the teachers expressed concern about adequate teacher preparation prior to the assignment of a new teacher to the Academic Skills classes.

The district coordinator for all the instructional computing programs noted that with regard to teacher preparation in the academic area, only teachers certified in the subject areas of English and mathematics were selected to teach the Academic Skills English and mathematics classes. Consequently, no extra subject area inservice was given to them prior to assignment to these classes. However, as far as the computer technology is concerned, two days of instruction in a computer lab was provided each year to new teachers. This was done on school time in one of the school labs which was closed to students for two days just for the purpose of teacher training. Although the district
coordinator believed this length of training to be inadequate, he also believed that the individual training provided by him and also by consultants from CCC, available to teachers on a request basis helped to fill the gap. He attributed some of the high teacher turnover and the concern for teacher preparation to what he called "hardware shock."

He went on to add,

But when they find out that their main job is to guide instruction, and that the system takes care of itself and they just need to keep records and know where the kids are and know what's taught in that area, they don't really have to be concerned with trouble-shooting the hardware, they don't have near as much anxiety.

Teachers and principals reported a variety of viewpoints regarding teacher training and some diversity in dealing with this aspect of the program. A teacher at School A revealed that he had no district inservice related to teaching the Academic Skills classes. However, he had college classes in numerical methods and BASIC programming as well as previous work experience which required using computers. He expressed no concern about the lack of district inservice and seemed comfortable with the use of the equipment in a teaching situation. The principal at School B indicated that one of the Academic Skills teachers in his building was in the initial district training sessions when the program was implemented in all the junior high schools. Since that time this teacher had taken the
initiative to encourage other teachers in the building to use the lab and to teach them how to use it. In addition to individual instruction with teachers, she also used the software program provided by CCC in computer literacy to train the other teachers. Although this teacher had no prior experience in using computers in the classroom, she did have six years experience in working with remedial students. She viewed herself as a specialist in this area and was enthusiastic about her role in the program. Prior to her first assignment to Academic Skills three years ago, she reported she had one hour of inservice with a CCC consultant. Feeling pressed regarding the lack of preparation, she read the training material and taught herself by trial and error.

Reporting a very different experience with the teacher training preservice, the teacher at School C had two or three two-day district inservice sessions provided by the district during school days. She was provided with substitute teachers for those days away from her classes. Believing that her training was more than adequate, she was quite comfortable with her assignment. The principal reported that this teacher was very helpful to other teachers in the building such as the special education teacher and the teacher for the enriched seventh grade math
class in the use of the computer lab as a supplement to classroom instruction.

Having similar experiences with teacher preparation as those with the teacher at School C, the teacher at school D also had two or three, two-day workshops. However, not being able to absorb everything she needed to know during these intensive training sessions, she also taught herself using the manuals and working independently at a computer terminal. The principal at this school also reported that some of the teachers in his building had been attending a ten-week computer literacy course taught at night once a week in his building during the 1984-85 school year. It was a three-hour college credit course for teachers seeking certification in the teaching of computer literacy.

At School E several teachers had the two-day district inservice the first year. After that the principal discovered that training time could be reduced to one-half a day if the training for new teachers were provided by one of the already experienced teachers in the building. In this way the training could be more personalized and individualized to meet the specific needs of teachers. The teachers in School F also attended the inservice programs offered by the district on several different occasions.
Student Achievement

The formal measure of achievement used by the west Texas school district was the standardized Metropolitan Achievement Test administered in the spring of the year to all students in the district. It had been used since the mid-1970's. Table V shows the scores for students in grades seven and nine for the years 1982-1985, inclusive, on the mathematics subtests.

**TABLE V**

<table>
<thead>
<tr>
<th>MATHEMATICS ACHIEVEMENT TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCALE SCORES FOR THE</td>
</tr>
<tr>
<td>WEST TEXAS DISTRICT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School Year</th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
<th>School D</th>
<th>School E</th>
<th>School F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Gr</td>
<td>NA</td>
<td>706</td>
<td>710</td>
<td>726</td>
<td>723</td>
<td>765</td>
</tr>
<tr>
<td>9th Gr</td>
<td>753</td>
<td>768</td>
<td>762</td>
<td>799</td>
<td>802</td>
<td>853</td>
</tr>
<tr>
<td>1982-83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Gr</td>
<td>694</td>
<td>704</td>
<td>711</td>
<td>734</td>
<td>725</td>
<td>735</td>
</tr>
<tr>
<td>9th Gr</td>
<td>761</td>
<td>770</td>
<td>768</td>
<td>794</td>
<td>792</td>
<td>814</td>
</tr>
<tr>
<td>1983-84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Gr</td>
<td>705</td>
<td>728</td>
<td>723</td>
<td>729</td>
<td>731</td>
<td>739</td>
</tr>
<tr>
<td>9th Gr</td>
<td>783</td>
<td>790</td>
<td>785</td>
<td>818</td>
<td>804</td>
<td>825</td>
</tr>
<tr>
<td>1984-85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th Gr</td>
<td>696</td>
<td>718</td>
<td>725</td>
<td>725</td>
<td>725</td>
<td>747</td>
</tr>
<tr>
<td>9th Gr</td>
<td>773</td>
<td>775</td>
<td>789</td>
<td>806</td>
<td>805</td>
<td>813</td>
</tr>
</tbody>
</table>
Another measure of achievement certainly less formal but none the less important was the observations of teachers and principals and their impressions regarding the impact of instructional programs upon students. During the interviews with both teachers and principals, they were asked if they felt the students were benefiting from the Academic Skills classes. Not only did these individuals reply to this direct question but they also volunteered information regarding benefits received by the students in response to other questions. Their responses varied somewhat and are summarized as follows.

**School A**

Describing the students in the Academic Skills classes as having "lost their drive in trying to learn with the regular teacher," the principal was enthusiastic about the program because the program gave these students a chance to succeed in a different environment, using motivating equipment, and more individual attention in a smaller class. Although he admitted that there were some students for whom the program was not helpful, he believed that most students did benefit from the program, and that some students even request to be placed in the program. He said the teachers in his building believe this also.

Everyone that you talk with out there will let you know that they can see progress. Now it's slow; it's not real fast, but you can see when the kid came to them, that by the end of the
semester or the end of the year, they can tell that there's been a tremendous amount of progress made with the kid. Yet, for many of them they're still not able to appear and keep up with the others. But they have broadened from where they started at the beginning to a point.

The teacher's comments were reflective of those of the principal. He said, "I feel quite firmly that this or something like it should be in every classroom."

Elaborating further he added,

**Teacher:** I've seen some pretty tremendous gains. I saw one little girl go from a 5.1 grade equivalency to a 10.6.

**Interviewer:** In one year.

**Teacher:** In one year.

**Interviewer:** And she was proud.

**Teacher:** She wasn't the only one!

**Interviewer:** What happened to her? Did she go into a regular classroom?

**Teacher:** No. She's over here. I could put her in a regular classroom, but she's doing just fine, and she'll be ready for a regular classroom next year.

**Interviewer:** She'll go into regular eighth grade next year, and she'll do OK, you think?

**Teacher:** I think she'll do quite fine. Now, why she was at 5.1, I don't know.

**School B**

Lending his total support to the program, the principal at this school believed it had a greater chance of success with younger students. Recalling that the first year the
program was in his building the target population was ninth
graders, he responds, "Those were kids who'd never had any
success in school, and even though they were having instant
feedback on the computer, they didn't know how to handle it.
Success was a stranger to them. But with the younger kids,
they respond to it."

The teacher at School B had an attitude that was con-
sistent with that of the principal. She believed the
program was good for most students although there were a few
"who just cannot learn from the computer because their
attention span is so short." Agreeing with the teacher at
School A, she believed the program should also be available
to students in the eighth and ninth grades who still need
it. She told a story about a seventeen-year-old ninth grade
boy who was in the program and announced to her that he
hated math. But she worked with him on a one-to-one basis
and taught him. Then she said he practiced his skills on
the computer and became so proficient that he was teaching
the other students. She said the positive reinforcement and
practice from the computer motivated him. She added that it
motivated many students.

School C

The principal at this building believed that the atti-
tude of the student was a major factor influencing their
achievement. Being more selective in choosing students for the program would result in a higher success rate for the students. His main concern was that the desire of the students for education seemed to have subsided. He added, "Maybe the computer, maybe the video situation would assist and bring back this desire. If that's the case, then we need it. Because we need something to stimulate interest."

The teacher agreed that there were some students who did not benefit very much because of their attitudes. Although the students passed the computer part of the class activity, they did not turn in homework papers or pass the tests. But with most other students with skills that are at the third, fourth or fifth grade level, the work with the computer built their confidence, and helped them to improve. Although only a few of the seventh grade students would be ready to move into a regular eighth grade math class, most of the students had progressed several grade levels in achievement. Some students "were pretty low to start with."

These students would be assigned to a basic math class in the eighth grade. She would like to see these students continue to have access to the computer labs instead of just being dropped.

If they had the opportunity to continue on, it would probably continue to build up their skills, because a lot of their skills, they've learned on the computer, their basic math skills. . . . They practice them and they miss them and then it kind of dawns on them some way, "well that's how you work this problem," or "I see this concept,"
or whatever. And it's just the computer and them. There's no one there knowing that they're messing up. And there's no pressure. So, I think it's just a big help to them.

School D

Prior to the implementing of the Academic Skills program using the computers, this school had a tutoring program which was not very effective according to the principal. Students were pulled out of their regular classes for help sessions. Apparently, this was consistent with what was happening at the other junior high schools because he added that "No one else in town did either (think it was effective), so we went to the computer program." His impression of the current program was that students are progressing at more than one grade level per year. He indicated that the computer program kept track of each student's progress and that the teachers used this information in planning instruction for each individual student. The district coordinator also discussed this record keeping feature of the CCC program, but quickly added that the district neither collected nor used this information for any kind of evaluative purposes. It was strictly for the purpose of aiding instruction. The only problem the principal saw with this program was that the space available was really too small to accommodate the program. However, he added, "I've been very pleased considering that there is too
much density there, I think, for the set-up. We've had good behavior, and the kids work. It's doing very well."

As in other schools the teacher reflected the principal's attitude in her comments.

Well, I really think it's a positive program and I feel these kids need a good background. This solid, firm background, they can always go in any direction from there. And I think this program does give that to them. Because sometimes we have as many as one hundred and some odd problems to a lesson. They get a lot of repetition, and a lot of drill. And the areas that they're weak in, they're put back on those same type of problems until they get them right, and then they move. So I feel like it's a very worthwhile program.

School E

The principal at this school was very positive in his attitude that the Academic Skills program helped students who were behind in grade level achievement. His attitude was reinforced by the fact that he scheduled two sections into the computer lab each period. If a student was able to come up to grade level during the school year, he was transferred into a regular class and another student needing the help was moved into the vacated place in the Academic Skills class. In this way all seventh grade students who needed the program were served, and occasionally there was room for an eighth grade student. Not having had the program for eighth graders was unfortunate, he believed. When asked if they would add a computer assisted program for eighth
graders, the principal replied, "No, we will not. Just because we don't have enough money."

The teacher interviewed at this school had more negative than positive feelings about the Academic Skills classes. A knowledgeable person on the technical aspects of computer-assisted instruction and also very analytical in his evaluation of the program, he believed that any lack of success could be attributed to student burn out with the daily routine. At the beginning of the year he reported that students were enthusiastic and eager to work at their computer terminals, but by the beginning of the second semester they were beginning to tire of it. (Teachers in other buildings reported this also. Two of them said they combated the problem by having contests, announcing the names of students who had progressed the most, and rewarding students with candy. The teacher at School A said that after he started handing out the candy, he heard no more complaints about working at the computer terminals.) When asked if he thought his students were benefiting from the Academic Skills classes, he replied that none of his students had reached the seventh grade level, and that as a general rule his students did not benefit.
School F

The principal in this school was positive in his attitude about the benefits of the computer programs on the academic achievement of students. He would like to have computers in each subject area at each grade level which would be available to students not only during class periods, but also before and after school and during lunch periods. The CAI labs were currently being opened by the teachers to give students the opportunity to work on the computers on their own time.

Although the teacher expressed the same concerns about computer burn-out as did other teachers, she believed the students really did learn from the Academic Skills classes. She reported that technical problems with the computer during the 1984-85 school year had caused some students to become discouraged. Some of the problems had been down time and incorrect responses by the computer to correct answers keyed into the computer terminals by the students. She attributed these problems to a recent upgrade of the equipment and software which had not been completely "de-bugged."

Socioeconomic Status of Students

Table VI gives the percentage of students qualifying for the free and reduced price lunch program for the years 1981-82 through 1984-85, inclusive.
TABLE VI

THE PERCENTAGE OF STUDENTS QUALIFYING
FOR FREE AND REDUCED PRICE LUNCHES
IN THE WEST TEXAS DISTRICT

<table>
<thead>
<tr>
<th>School Year</th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
<th>School D</th>
<th>School E</th>
<th>School F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-82</td>
<td>NA</td>
<td>23</td>
<td>18</td>
<td>10</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>1982-83</td>
<td>11</td>
<td>20</td>
<td>20</td>
<td>9</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>1983-84</td>
<td>36</td>
<td>19</td>
<td>22</td>
<td>18</td>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td>1984-85</td>
<td>36</td>
<td>17</td>
<td>25</td>
<td>22</td>
<td>16</td>
<td>13</td>
</tr>
</tbody>
</table>

As was noted earlier School G was a predominately black junior high school which was closed in 1982 as a result of court-ordered desegregation. Beginning in 1982-83 school boundaries were changed, and bussing to achieve a racial balance was implemented. Since that time a tri-ethnic committee advised the school board on a regular basis with regard to maintaining the balance.

Other measures of the socioeconomic status of students became evident in the interviews with the principals. Each of them was asked if they ever had any feedback from parents pursuant to the Academic Skills classes. Five of the six responded with either a "no" or "not too much." Most of them attributed this to the fact that lower achieving students frequently came from homes where the parents were not very interested in education. One principal commented that they
"have tried to get people interested, to come to school to be interested in what their children are doing . . . but as of this time I have not had a single parent ask any question about the program, come by to watch or indicate any interest whatsoever."

Although one principal said he rarely had feedback from parents, he did relate his observations of the students showing their parents how to work the computer terminals during "back to school" night. He described the scene, "They do go in there (the computer lab), and they start the machine. The kid shows the parents, and they smile." The one principal (School D) who said he did get parent feedback indicated that many parents in his school district wanted their children to be enrolled in the program. He said the program really had a positive image in his district.

Teachers were asked the same question with regard to parent feedback and their responses were much the same as those of the principals. One teacher reported that even though she sent a letter to the parents of each of her students at the end of each grading period showing the students average and what they have done, she got no replies. She believed that the students got little incentive from home, and this was part of their problem. Another teacher who also sent letters home did receive a reply from an irate parent who did not know his son was so far behind
and was in the computer class. The teacher said that he bore the brunt of the parent's attack even though he had not been the one who made the decision to assign the boy to the Academic Skills class.

The teacher, at the school (School D) where the principal reported positive attitudes from parents, also noted approving comments from parents.

I have heard a lot of things indirectly from other teachers. These students were in regular classroom situations and not doing well, and they were recommended by their teachers to come into this class. And I've heard through those teachers that they have gotten feedback from parents on how pleased they were with their children and the progress they were making and how their grades seemed to come up; not only in this area, but in everything else because it gives them confidence that they're lacking. We've had real positive feedback.

Students were also asked in the interviews with them if they ever discussed the Academic Skills class or their work on the computer with their folks at home. Four of the six said, "yes," the others said, "not really" or "not much." Of the ones who have a positive response, all said that their parents liked it that they were in the program and they thought the program was helping them. One commented on his parents view of the program, "They think it's educational for me and my brothers at their [elementary] school. They have just gotten computers at their school; so, our family's getting into the computers, too."
Problems

School A

The mini-computer which ran the remote labs at Schools A, B, and several elementary schools was located at School A. When this campus was used as a high school prior to 1982, a full time aide was employed to operate the mini-
computer and trouble shoot the problems of the two remote labs. When the school became a junior high, this respon-
sibility was given to one of the Academic Skills Teachers. The principal indicated that this was a problem.

Every year we almost had to put some new person out there, and then that person is having to be responsible when the machine is down at the other schools, to go out and make the correction. And many times the other schools are down for maybe an hour or two before we can get it up compared to when the aide was there. The aide kept it up all the time. But many times with this person's planning period or this person's teaching class somewhere else, there's no one out there. So those people, they're just lost for a while.

The teacher at this school echoed the principal's remarks.

The only problem I have with it is the inter-
ruptions. Because if I have somebody else that's having problems on the network, then I have to stop what I'm doing and go reload the system or see what the problem is. Suppose I lose a disk drive or something. The disk drive kicks out. Then I have to stop what I'm doing and go in here and reboot the disk drive which means that I have to power all the way down and then power all the way back up which is about a ten minute process. So in terms of my time in the classroom - that's the only problem that I've had with it.
School B

This school used the mini-computer located at School A. The teacher said that the only problem they had was with the system being down so much. She said she heard that it was software problems.

It's down probably three weeks out of the year.

. . . We had a new person in charge of it [the mini-computer] this year than we did last year. And that hurts things. And if he's not around then there's a big problem. Or we wait a couple of days for a technician to come out. I had a fuse blown and that was my problem for two days. Had nothing to do with [School A].

School C

The only problem this principal mentioned was that of space for the computer lab since it must be in a secured area where the temperature can be controlled.

School D

The teacher reported "there are a lot of bugs in the software." The mini-computer used by this school was exchanged during the 1984-85 school year, and it apparently did not have adequate memory to run all the software programs available for the Academic Skills classes.

School E

The principal commented,

I think we've had too much down time. That would be my biggest complaint about the entire system is that we've had too much down time. Anytime - see, our computers feed into a central location.

. . . They have to be operable up there before
we can be operable. And then it's kind of a domino effect, you know.

The teacher commented,

They have had so many problems this year. Last year we thought was bad. We would keep a record of every time one of the computers would go wrong or half of the computers would go wrong. Usually, either one computer would go wrong, or half the terminals would go wrong, or the whole thing would go down. And we'd keep a record of it.

School F

Regarding problems, the principal noted,

Well, I hear different things about it. I think one of the problems we have, we have some kids that are taking two classes. In other words they're in both basic English and basic math. And I don't believe that two classes like that are very good. They ought to be in one. But to determine ... I don't really know. That's the one fault I've heard, you know, a lot of times the kids have too much sitting at the machine and that type of thing.

The teacher in this building also reflected this problem.

Our program is set up with remedial students. They are to stay on the computer twenty minutes a day, and then they are to have thirty-five minutes of block teaching. So we are to cover the essential elements in addition to spending twenty minutes on the computer. The problem that I've seen is that they also have English for twenty minutes, and usually the slow students in math are also slow English students. Therefore, they are on the computer forty minutes a day, and toward the beginning of the second semester, there's a lot of computer burn-out.
THE NORTH TEXAS DISTRICT

Computer Equipment, Software, and Related Costs

The north Texas school district had nine junior high schools, eight of which were used in this study and were designated by capital letters - School A, B, C, D, E, F, G, and H. In this district the use of computers in the junior high schools began in the 1980-81 school year when the district bought one Commodore PET computer and one tape drive for each of three compensatory education mathematics labs in Schools B, E, and F. The program was expanded in the 1981-82 school year when ten Commodore PETs and ten tape drives were purchased for Schools A, C, D, G, and H, and nine of the same sets were purchased for Schools B, E, and F making a total of ten sets for each junior high school for use by the mathematics departments. Three sets, each set consisting of one Commodore PET computer and one tape drive, were purchased for each junior high school for use by the English departments. It was in the 1981-82 school year that Chapter II federal funds became available for unrestricted use. Since that time those funds have been used largely for the purchase of computer equipment. The 1982-83 school year saw the addition of one more PET computer, one printer, and one disk drive to each junior high school mathematics department. In that year three PETs and one disk drive were
purchased for five junior high schools (Schools A, C, D, E, and H) to supplement the teaching of reading in the seventh grade. School G received a set of these for the teaching of reading in the 1983-84 school year. Equipment was also added to every junior high mathematics department in the 1983-84 school year, and it consisted of three disk drives and one printer. In the 1984-85 school year no more equipment was purchased for the teaching of English or mathematics but additional equipment was purchased for the teaching of reading. Schools A, C, D, E, and F received sets consisting of eight Commodore C64 computers, eight monitors, one disk drive, one printer, and the necessary cables. Schools B, G, and H each received two sets of the same type of equipment or equipment for two classrooms.

Other equipment purchased in the 1984-85 school year was for the purpose of supplementing instruction in the special education department. A set of equipment consisting of one Commodore C64 computer, one monitor, and one disk drive was purchased for each special education resource teacher in each junior high school. One printer per building was purchased for this program. Also added during this school year was a classroom set of twenty-four C64 computers, twenty-four monitors, three disk drives, and three printers in each of two schools, School E and School F. The purpose for the addition of these sets was for a pilot class
in word processing at School E and for a pilot one semester class in computer literacy at School F. The computers at School E were received late in the year, and the pilot class in word processing would not be implemented until the 1985-86 school year. However, the computers at School F were received prior to the beginning of the 1984-85 school year, and five classes of computer literacy were taught each semester during the year.

In addition to the computer equipment purchased for each of the junior high schools a computer teacher training center was established at the central administration building in the 1982-83 school year consisting of sixteen Commodore PET computers, eight disk drives, and two printers. This set of equipment was moved to the elementary schools after one year because Commodore discontinued the manufacture of the PET computers. In the 1983-84 school year this equipment was replaced with sixteen Commodore C64 computers, two disk drives, two printers, and VIC switches to network the computers. The purpose of this facility was to train teachers in the operation of computers and in their use in the classroom for instruction. All teachers in the district including both elementary and secondary teachers were invited to participate in the classes on a voluntary basis.
Table VII is a chart which summarizes the above narrative. It also shows the corresponding expenditures for all of this equipment.

Although the planning, budgeting, receiving, and installing of all of the equipment purchased over this five-year period was done primarily by school district central curriculum administrators, implementation and use of the equipment was left almost entirely to teachers and building principals using guidelines furnished by central administrators. By the 1984-85 school year three of the schools (Schools A, C, and D) had combined the eleven Commodore PET computers purchased for mathematics with the three purchased for English and the three purchased for reading to make one lab of seventeen computers to be used both by the mathematics and the language arts departments on a scheduled basis. Schools B, F, G, and H had combined the eleven math computers with the three English computers to make a lab of fourteen computers. School E elected to use the computers separately by the individual academic departments. The exception to this by School E occurred in the 1983-84 school year when it was necessary because of a massive remodeling project taking place at the school for it to double-shift with School C for the fall semester, School C using the building in the morning and School E using the building in the afternoon. For this one semester the computers were combined to make a lab with twenty-eight computers.
## TABLE VII

**EXPENDITURES FOR THE NORTH TEXAS DISTRICT**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment and Cost Program</strong></td>
<td>10 PETs</td>
<td>10 Tape Drives</td>
<td>3 PETs</td>
<td>3 Tape Drives</td>
<td>1 PET</td>
<td>3 Disc Drive</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>Math</td>
<td>English</td>
<td>English</td>
<td>Math</td>
<td>1 Printer</td>
</tr>
<tr>
<td></td>
<td>$1500.00</td>
<td>$1500.00</td>
<td>$1750.00</td>
<td>$1750.00</td>
<td>$100.00</td>
<td>$2042.00</td>
</tr>
<tr>
<td></td>
<td>$375.00</td>
<td>$375.00</td>
<td>$375.00</td>
<td>$375.00</td>
<td>$445.00</td>
<td>$504.00</td>
</tr>
<tr>
<td>School B</td>
<td>1 PET</td>
<td>9 Tape Drives</td>
<td>3 PETs</td>
<td>3 Tape Drives</td>
<td>1 PET</td>
<td>3 Disc Drives</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>Math</td>
<td>English</td>
<td>English</td>
<td>Math</td>
<td>1 Printer</td>
</tr>
<tr>
<td></td>
<td>$580.00</td>
<td>$220.00</td>
<td>$1750.00</td>
<td>$1750.00</td>
<td>$100.00</td>
<td>$2042.00</td>
</tr>
<tr>
<td></td>
<td>$375.00</td>
<td>$375.00</td>
<td>$375.00</td>
<td>$375.00</td>
<td>$445.00</td>
<td>$504.00</td>
</tr>
</tbody>
</table>

17 PETs in one lab combined in Eng. 3 Read & 11 Math in 1983-84 to make one lab used by both departments.

2 C64's Sp. Ed.

7 C64's Reading

14 PETs - combined 3 from Eng. 11 from Math to make one lab in 198-8. Used by both departments.
### TABLE VII (Continued)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 PETS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17 PETS</td>
</tr>
<tr>
<td>Math</td>
<td>10 Tape Drives</td>
<td>10 PET</td>
<td>1 Printer</td>
<td>3 Disc Drives</td>
<td>8 C64's</td>
<td>in one lab</td>
</tr>
<tr>
<td></td>
<td>$5800.00</td>
<td>1 Disc Drive Math</td>
<td>1 Printer Math</td>
<td>3 Disc Drives Math</td>
<td>8 C64's</td>
<td>combined 3 Eng. 3</td>
</tr>
<tr>
<td></td>
<td>$1684.00</td>
<td>Cables</td>
<td>$2042.00</td>
<td>1 Printer</td>
<td>8 Monitors</td>
<td>Read &amp; 11 Math to</td>
</tr>
<tr>
<td></td>
<td>$100.00</td>
<td>Supplies</td>
<td>$100.00</td>
<td>1 Disk Drive Reading</td>
<td>8 Ser. Cables</td>
<td>make one lab used</td>
</tr>
<tr>
<td></td>
<td>$375.00</td>
<td>Maint.</td>
<td>$504.00</td>
<td>1 Printer</td>
<td>1 Disc Drives Reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 Printer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1227.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$504.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$15,689.00</td>
</tr>
</tbody>
</table>

### School D

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 PETS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17 PETS</td>
</tr>
<tr>
<td>Math</td>
<td>10 Tape Drives</td>
<td>10 PET</td>
<td>1 Printer</td>
<td>3 Disc Drives</td>
<td>8 C64's</td>
<td>in one lab</td>
</tr>
<tr>
<td></td>
<td>$5800.00</td>
<td>1 Disc Drive Math</td>
<td>1 Printer Math</td>
<td>3 Disc Drives Math</td>
<td>8 C64's</td>
<td>combined 3 Eng. 3</td>
</tr>
<tr>
<td></td>
<td>$1684.00</td>
<td>Cables</td>
<td>$2042.00</td>
<td>1 Printer</td>
<td>8 Monitors</td>
<td>Read &amp; 11 Math to</td>
</tr>
<tr>
<td></td>
<td>$100.00</td>
<td>Supplies</td>
<td>$100.00</td>
<td>1 Disk Drive Reading</td>
<td>8 Ser. Cables</td>
<td>make one lab used</td>
</tr>
<tr>
<td></td>
<td>$375.00</td>
<td>Maint.</td>
<td>$504.00</td>
<td>1 Printer</td>
<td>1 Disc Drives Reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$100.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1227.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$504.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$15,688.00</td>
</tr>
<tr>
<td>----------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td></td>
<td>1 PET</td>
<td>9 PETS Math</td>
<td>1 PET Math</td>
<td>3 Disc Drive Math</td>
<td>8 C64's Monitors</td>
<td>11 PETS kept to-</td>
</tr>
<tr>
<td></td>
<td>1 Tape Drive</td>
<td>9 Tape Drives</td>
<td>1 Printer</td>
<td>1 Printer</td>
<td>8 Monitors</td>
<td>gether for last</td>
</tr>
<tr>
<td></td>
<td>$580.00</td>
<td>$5220.00</td>
<td>1 Disc Drive</td>
<td>2 Disc Drive Reading</td>
<td>8 Ser. Cables</td>
<td>semester then 2 to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Math</td>
<td>Cables</td>
<td>1 Disk Drive Reading</td>
<td>1 Printer</td>
</tr>
<tr>
<td></td>
<td>$100.00</td>
<td>$100.00</td>
<td>$1684.00</td>
<td>$2042.00</td>
<td>$2405.00</td>
<td>$4405.00</td>
</tr>
<tr>
<td></td>
<td>Supplies</td>
<td>Supplies</td>
<td>$100.00</td>
<td>Supplies</td>
<td>$504.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$445.00</td>
<td>$445.00</td>
<td>$504.00</td>
<td>$504.00</td>
<td>$505.00</td>
<td>$13,215.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 PET</td>
<td>9 PETS Math</td>
<td>1 PET Math</td>
<td>3 Disc Drive Math</td>
<td>8 C64's Monitors</td>
<td>16 PETS - combined</td>
</tr>
<tr>
<td></td>
<td>1 Tape Drive</td>
<td>9 Tape Drives</td>
<td>1 Printer</td>
<td>1 Printer</td>
<td>8 Monitors</td>
<td>3 from Eng. and 11</td>
</tr>
<tr>
<td></td>
<td>$580.00</td>
<td>$5220.00</td>
<td>1 Disc Drive</td>
<td>2 Disc Drive Reading</td>
<td>8 Ser. Cables</td>
<td>from math to make</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Math</td>
<td>Cables</td>
<td>1 Disk Drive Reading</td>
<td>one lab in 198-8.</td>
</tr>
<tr>
<td></td>
<td>$100.00</td>
<td>$100.00</td>
<td>$1684.00</td>
<td>$2042.00</td>
<td>$2405.00</td>
<td>Used by both</td>
</tr>
<tr>
<td></td>
<td>Supplies</td>
<td>Supplies</td>
<td>$100.00</td>
<td>Supplies</td>
<td>$504.00</td>
<td>departments.</td>
</tr>
<tr>
<td></td>
<td>$445.00</td>
<td>$445.00</td>
<td>$504.00</td>
<td>$504.00</td>
<td>$505.00</td>
<td>5 C64's Sp. Ed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 C64's Reading</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$13,854.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 PETS</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td></td>
</tr>
<tr>
<td>10 Tape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 PETS</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td></td>
</tr>
<tr>
<td>3 Tape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$100.00</td>
<td>Supplies</td>
<td>$100.00</td>
<td>Supplies</td>
<td>$100.00</td>
<td>Supplies</td>
<td></td>
</tr>
<tr>
<td>$375.00</td>
<td>Maint.</td>
<td>$404.00</td>
<td>Maint.</td>
<td>$505.00</td>
<td>Maint.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 PETS</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td>$5800.00</td>
<td></td>
</tr>
<tr>
<td>10 Tape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 PETS</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td>$1740.00</td>
<td></td>
</tr>
<tr>
<td>3 Tape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$100.00</td>
<td>Supplies</td>
<td>$100.00</td>
<td>Supplies</td>
<td>$505.00</td>
<td>Maint.</td>
<td></td>
</tr>
<tr>
<td>$375.00</td>
<td>Maint.</td>
<td>$444.00</td>
<td>Maint.</td>
<td>$505.00</td>
<td>Maint.</td>
<td></td>
</tr>
<tr>
<td>Teacher</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training Center</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 PETS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>$2040.00</td>
<td>$60,640.00</td>
<td>$24,412.00</td>
<td>$21,171.00</td>
<td>$4,835.00</td>
<td>$113,098.00*</td>
</tr>
</tbody>
</table>

*The grand total includes only those costs which were either originally or eventually dedicated to instruction in mathematics.
Much of the software for the Commodore computers existed in the public domain. During the years between 1980 and 1985 many of the teachers and central office administrators acquired, previewed, edited, and copied a variety of programs for dispersion and use in the junior high school classrooms. The material on these programs included drill and practice and educational games in the basic skills not only in reading and mathematics but also in other subject areas such as science and social studies. There were also other programs found which provided tutorial instruction in the use of the computer and in keyboard skills. Since most of these programs were free, very little money was spent on software during these years.

Objectives of Computer Instruction

The "Five-year Priorities Plan, 1983-88" for the district listed as a goal of instruction that "students will acquire a knowledge of the traditionally accepted fundamentals in arithmetic in the early elementary grades, accompanied by studies in higher mathematics as they progress through the upper grades." Using the average percentile score on the California Achievement Test (CAT) in mathematics computation administered in the 1982-83 school year to eighth grade students, the district recognized a need that students should improve in basic computation
skills. The following strategies and operation activities were listed as a means of fulfilling this student need:

1983-84. Educational innovations utilizing computer assisted instruction will be extended throughout the Junior High Math Curriculum.

1984-85. Computers are to be purchased in the ratio of one computer for approximately every fifty students in each of the Junior High Schools.

1983-88. Provide continuous inservice programs and workshops for the Junior High School teachers. These programs and workshops will be held during the school year and during the summer in order to receive maximum utility from the computing facilities.

In order to implement the goals finalized in the "Five-year Priorities Plan" a unit of instruction was added to the eighth grade mathematics curriculum. It was required by the district that the unit should cover a time period of from three to six weeks, and a curriculum guide was developed over a period of two years for the use of classroom teachers in the teaching of the unit. The guide titled "Computer Objectives - Eighth Grade Math" consisted of two parts, "Part One Objectives and Resources" and "Part Two Learning Activities in Four Sections." Objectives listed in the guide were specifically targeted toward teaching computer programming to the students and covered such topics as keyboard familiarization, print statements, BASIC programs, variables, translating a program, and applying programming principles. However, the section on learning activities
focused the programming skills around applications in mathematics computation. For example there were lessons on such skills as order of operations and finding the area of a triangle.

Interviews with teachers indicated that many of them plan the scheduling of the computer unit either to coincide with or to follow units in the eighth grade mathematics course of study in order to supplement or enhance certain topics in the regular curriculum. Commenting on this aspect of the computer unit, the teacher at School C related,

Most of us are finished. We tend to do the computers earlier in the year. I do mine actually later than those people. I do mine later because I emphasize a little more programming than some other people. I want to do it after we've done geometry because those formulas make for very easy yet efficient programs. To me it's a real good unit to combine with programming because they can see this is actually useful, and they can realize they know more than they thought.

The teacher at School G indicated that the teachers in this building have written a folder of material for the computer unit and that it was organized around the order of operations unit. She elaborated,

Mainly the math problems that they are doing while they are in there at the particular time are order of operations, and we get into some very difficult order of operations that . . . and we make them work them on their own first. And then they can put them into the computer and compare their answers to the computer's answers and why theirs didn't come out to be the same and what they did wrong.
The students interviewed reflected the comments made by their teachers. When asked what kinds of work they had done with the computers the student at School H responded that his teacher gave them "these small little programs like to find math problem answers." He also mentioned that he had done a program to find the area of a triangle and had played a Tic Tac Toe game "that had equations in the box, and you had to do the equation as a problem and write in the answer that's right." Recalling that her class went to the computers on Wednesdays, the student at School B related, "she handed worksheets out for use, and we'd do programs off them. And we learned how to draw pictures on it, and how to use them, and we learned how to do math and how to write programs on them." The student at School G said that in addition to learning how to write programs for the computer, the programs they wrote reinforced material they had already learned in class. "We sort of reviewed some stuff we'd already done earlier in the year, like order of operations. We did that on the computer, computer symbols, and some other things that we'd already done that we knew how."

Student Access to Computers

Staff members in each school seemed to believe that they had a requirement to teach a unit on computer programming and usage to all eighth grade and seventh grade
honors mathematics classes. However, individual school staffs viewed the requirement differently with regard to the length of the unit. The time ranged from three to six weeks. Scheduling of the unit was left entirely to the discretion of the mathematics teachers in each building and was managed through the use of a monthly calendar on which individual teachers wrote their names for the days and class periods they chose to use the lab. Timing and scheduling varied not only from school to school but also from year to year in individual schools. The following is a description of the way in which each school used the computer and an account of how much access individual students had to a computer.

**School A**

The principal reported that every eighth grade math teacher was required to use the lab, but that other teachers such as the seventh grade grammar teachers could choose to use it when it was not otherwise in use. The teacher related that in the beginning years they "were told" to teach the computer unit for six weeks to each eighth grade math and seventh grade honors math class. However, they could not fit six weeks instruction into an already crowded eighth grade curriculum, so they "combined some things" and currently they devoted about three weeks to the unit.
Scheduling themselves according to their own plans, each teacher spent three or four consecutive days in the lab each six weeks then returned to the classroom for testing or reviewing the week's work. Since their classes were large and there were seventeen computers in the lab, the teachers in this school assigned two students to a computer. At one time in prior years they assigned desk work to half the class while the others worked on the computers then changed midway through the class period. This was not a workable plan, however, because the students supposedly doing desk work were so distracted by and interested in the computer activity, that they could not stay on task. Classroom management was improved when they assigned two students to one computer for the entire period. Maximum student access to a computer for eighth grade students under this scheme would be approximately six hundred minutes or ten hours (twenty-five minutes per day for four days per week for six weeks).

School B

Although occasionally the English teachers or the social studies teachers used the computer lab, the principal reported that it was primarily used by the mathematics teachers in the building. He estimated that perhaps fifteen out of the forty-eight teachers in the building had taken classes to the computer lab at one time or another. The
mathematics teacher interviewed indicated that she brought each of her eighth grade mathematics classes to the lab one day a week every week for both semesters of the year. The other eighth grade math teachers also followed this plan. Except for her basic class which had only thirteen students, the students only had access to a computer for half the class period. For half the class period the students worked at a desk. She admitted that this plan was not very satisfactory because she said, "They get so excited! They want to reach over and pound on each other." Her belief was that each student needed to have a computer to use the entire class period. This view was unanimously shared by every other teacher interviewed. Under the plan outlined by this teacher, each eighth grade student had access to a computer for nine hundred minutes or fifteen hours each year (twenty-five minutes one day a week for each of thirty-six weeks except for basic students who were in smaller classes and might have twice the amount of time on a computer).

School C

The schedule for the use of the seventeen computers in the computer lab was worked out by the math teachers and was coordinated by the mathematics department leader. The principal reported that in the four years he had never heard a complaint from any teacher and he believed the individuals
in the mathematics department "have always cooperated very well." Although the teacher of the talented and gifted class took her students to the lab occasionally, the principal believed it was used primarily by the eighth grade mathematics classes. The teacher interviewed indicated that the English teachers also used the lab occasionally. The lab at this school had seventeen computers, eleven originally designated for mathematics, three for English, and three for reading. It was the choice of the teachers in the language arts and mathematics departments to put the computers all in one room in order to have more equipment to use with each class. She also reported that most eighth grade math teachers elected to teach the computer unit early in the school year although she preferred to do it later after she had taught the geometry unit. Reporting on their plan for using the lab, she related,

The first part of the year we come in for a week or two to learn a few commands, learn the keyboard, learning print, punctuation, etc. . . . and then we don't do a lot until after we've done the geometry just because of all the eighth grade curriculum, that's the easiest to coordinate with the computer.

Then she came back to the lab for about two weeks with her classes. She estimated spending five to six weeks in the lab during the year. The classes in this school were large so students could only have access to a computer for half a class period. For the other half they might be doing an
assignment not really related to computer usage. Maximum student access for eighth grade students in this building was seven hundred fifty minutes or twelve and one-half hours during the year (twenty-five minutes per class period for six weeks or thirty days).

School D

The teacher at this school disclosed that the first year they had the computers in the building which was the 1981-82 school year, each seventh and eighth grade mathematics teacher moved the ten computers into her room to teach a three week unit on computers. By the 1982-83 school year the principal had designated a room in the building as a computer lab, and all of the equipment was moved to this one location. Teachers then took their students one class at a time to the computer lab for instruction. During this school year each eighth grade teacher taught a three week unit on computers, the rationale being that the eighth grade students had three weeks exposure in the prior year as seventh graders. For the last two years each eighth grade mathematics and seventh grade honors class had one six weeks unit in computers. The teachers scheduled the labs in blocks of one week at a time. With seventeen computers available in the computer lab, two students shared a computer during one class period. Thus, maximum access per
student would be seven hundred fifty minutes or twelve and one half hours per year (twenty-five minutes per class period for six weeks or thirty class periods).

School E

This school was the only junior high school out of eight not to have combined equipment with the language arts department in order to have a larger classroom set of computers. As a consequence the mathematics department had only the eleven computers originally designated for its use. The exception to this was the 1983-84 school year when School E and School C double-shifted because of extensive remodeling done at School E. During this year the schools combined their computers for a minimum of twenty-eight computers for use by a single class. During this school year the eighth grade students at each school had twelve hundred minutes or twenty hours during the year (forty minutes per class period for six weeks or thirty class periods because each school used the building for only half a day.) Although the eighth grade math teachers used the lab one day a week all year long during the 1981-82 and 1982-83 school years, during the 1984-85 school year they scheduled themselves into the lab for blocks of six weeks each during the first semester. Because of the availability of only eleven computers, two or three students were assigned to each computer and according to the teacher,
It's crowded. There's too much goof-off time. While one's trying to do something the other two are watching. Some of the suggestions they've given us is to take half the class and put them on the computers and the other half sit in the center of the room. That didn't work for us for one reason. We didn't have enough room, didn't have enough chairs and desks. And while the people are at the computer, the people that are supposed to be working in the center of the room are too busy watching to do their work.

. . . It's just not worth it.

After each eighth grade teacher finished with the six weeks unit during the 1984-85 school year, the computers were dispersed in sets of two to those math teachers who wanted them in their rooms because as this teacher put it, "The way we feel about it, we would never have taken our class back if we didn't have to." Approximate access per student during this year with three students to a computer was five hundred minutes or eight and one-third hours (seventeen minutes per class period for six weeks or thirty class periods.)

School F

The same attitude was held by the teacher at this school. Speaking of her experiences she related,

Because we had only thirteen PETS, we had to share in my math classes. It just doesn't work out, because no matter how you pair up, one person is dominant over the other, and one learns and the other doesn't. I've had good kids teach the bad kids. But what happens is the kids that don't understand don't get taught by the ones that do. The ones that understand give it to them. Or they'll say "Here, do this," and they'll put in some wild thing that the other person doesn't know what it means. And that just doesn't work out. Even when you put two people
that are the same level together, one’s going to be dominant over the other.

The teachers in this building usually scheduled themselves into the lab one or two days week for the entire year. The teacher interviewed liked to choose the days in such a way as to emphasize the mathematics lessons being studied. "If we were doing fractions, I would probably take them and have them work a program with fractions. Or when we did per cents, they would work a problem involving percentages."

Students in this school, going to the lab one class period a week all year, working two to a computer would have access for nine hundred minutes or fifteen hours during the school year (twenty-five minutes per class period for thirty-six weeks.)

School G

Both the principal and the teacher referred to the eighth grade computer unit as a required three week unit. This principal related that in the first year, 1981-82, the teachers in his building taught a three week unit to all eighth, ninth, and seventh grade honors mathematics classes. After that year however, it had been used primarily by the eighth grade math teachers. He added that the English teachers did use the lab some when the math teachers were finished with it, but admits that the use of the lab was very limited except for eighth grade mathematics. He also
commented on the problem of two or three students to a computer. There were fourteen computers in the lab in this school. On the use of the lab the teacher commented,

It's gotten better in the last couple of years. We've worked it out a little bit differently. We were going one day a week. I took my classes in there and they wouldn't remember anything from what we did last Friday when we got in there the next Friday. They couldn't remember what we did. So we blocked it off this year and we take them in there for three solid weeks. And that's all we do for three weeks is just computers. It has helped a lot.

When asked if it was three weeks in the fall and three weeks in the spring, she replied, "Just three weeks for the whole year because we can't get all the rest of our curriculum taught if we go back again." Student access in this school was approximately three hundred seventy-five minutes or six and one fourth hours during the school year (twenty-five minutes per class period for three weeks or fifteen class periods.)

School H

Both the principal and the teacher in this school confirmed, as have staff from other schools, that scheduling students in the lab for one or two days a week for the entire school year resulted in students forgetting too much from one session to the next. This, compounded with the problem of having to assign two or three students to a computer because of having only fourteen computers in the lab
has resulted in one week block scheduling of the lab by the eighth grade and seventh grade honors mathematics teachers. The plan for 1984-85 was to take classes to the lab for one week each six weeks, but the students learned the material so much better that the unit was covered in three or four weeks. This has released the lab for use by teachers in other academic areas who, according to the principal, have elected to use the computer lab. Student access to a computer for eighth grade students is five hundred minutes or eight and one-third hours for the school year (twenty-five minutes per class period for four weeks or twenty class periods.)

Teacher Preparation

The director of instructional computing reviewed the evolution of the program for the addition of computers to the junior high schools for instruction and the teacher training aspects of the program as it developed through the years. In the early 1980's Chapter II federal funds became available for the first time with the acceptability of spending the money for computer equipment. Although there was not much available money in the early years, it was believed that "to let it go by would be a mistake." Consequently, what funds were available for this purpose were spent for equipment only, none for software and none
for teacher training. Since the equipment was being earmarked for junior high mathematics, the consensus was that "math teachers could figure it out."

In 1982-83 after seeing the problems of inadequate teacher training for the junior high math teachers in the previous years, a teacher training center was established at the central office primarily to train fifth grade elementary teachers for a program that was planned for implementation in the 1983-84 school year. During the 1982-83 school year the director of instructional computing taught classes both at the central office training center during school hours, with substitutes being provided for teachers, and after school at various junior high schools.

To expand the teacher training program, two teaching assistants were brought to the central office as permanent staff members to help with teaching computer classes for teachers. These two teaching assistants had been classroom teachers in prior years specializing in the teaching of computer usage. Classes were then available year round for teachers during school hours, after school, and during the summers. The content of these classes consisted of setting up equipment, trouble-shooting problems with equipment, loading and running software, and appropriateness of the use of computers for instruction.
Teachers have acquired their training for teaching the computer unit in a number of different ways. Their attitudes regarding this aspect of the program ranged from very positive to very negative. Both teachers and principals were asked to review the teacher preparation portion of the program. Listed below are their various responses.

School A - The Principal

We've done a couple of things here at this school to help the people utilize the computers better. When it first started out, we got the computers and nobody knew how to use them. So it was a "Here it is! Let's learn how" type situation. And I scheduled the district coordinator to come in one afternoon a week for about an hour at a time, and we ran about a six weeks inservice program for the teachers here at this school to teach them initially how to get into the computer, and the basic operation of the computer. That was for math teachers because they were being told, "You've got to teach this." But they didn't know how. So they had to be taught, and that's what we did. Since then, you know we're talking about three, four, five years ago, and since then they've had all sorts of opportunities to gain more expertise on their own through district inservice programs, and even out of district inservice programs through the colleges. We've had people who have done just about all of it. So, we've got a lot of people in our building now that are capable of working with the computer, and they don't consider themselves experts by any means, but they can certainly teach the elementary level that we're teaching.

The Teacher

All of us were in the same boat when they [the computers] first came. None of us had had a background or knew what to do. "Where do you turn it on?" My training was mostly during inservice. There's been a few, really very few inservices. [The district's teaching assistant]
taught a class last year that I really benefited from. It was after school - fifteen or eighteen hours worth.

School B - The Principal

As the first ones began to show up, we had no knowledge as to how to use them, but the inservice programs eventually helped the teachers and increased the enthusiasm that some of them had to begin with, and I think developed the confidence of those who had no knowledge of it whatsoever. And slowly, over the years, I think they've begun to be used more frequently by the teachers as they gain confidence.

The teacher took the course offered by the district teaching assistant during the 1983-84 school year, and this was her first introduction to computers. Provided with a substitute teacher to cover her classes, she went to the central office from one p.m. to four p.m. one day a week for six weeks. Her comment with regard to the person who conducted the class was, "She was very good!"

School C

The principal reported that during the first year or two that they had computers, the Regional Education Service Center sponsored classes in his building after school. It was a voluntary program for any teacher in the school district who wished to participate. He also commented that during the 1983-84 school year he and several teachers in the building took the class taught by the district teaching assistant.
The teacher at this school reported that one of the mathematics professors at the local university was a life-saver for this school district. He offered that summer [1981] a course specifically for teachers about to teach computer programming. He taught us just enough programming that we felt like we could at least start to answer the questions, know where to find the answers, and really saved our lives. He taught us a lot about how to teach programming, because it's a frustrating thing to try and get across. I took it as a methods class as much as a programming class. I took the second half of his course and then I started working on my master's degree in math with a computer science option. I have about fifteen hours in programming.

Regarding the other math teachers in the building and how they were trained she reported that three teachers went to the same university that she attended, two others attended another university for training, and two teachers used the district inservice courses. "So we all got it in our own way," she related.

School D - The Principal

I was pretty much disappointed when we first started out on it. All of a sudden we got fifteen computers and I didn't have a room for it, very little advance warning, teachers had not been trained, they didn't know what to do, and yet they were expected to go up there with the kids and start teaching them on the computer. I think we ought to have had a training period well in advance of the purchase of the computers.

With regard to current training for teachers he replied that current opportunities for teachers were adequate noting that the district coordinator "is setting up programs for them
almost constantly." The teacher at this school assumed full responsibility for teaching herself how to use the computer. After purchasing her own computer, she bought books, checked out books from local libraries, and learned by trial and error during the summer of 1981. Since that time she has been very active in computer clubs and other associations of people interested in computers. She has also been a key person not only in her own school in training other teachers, but also in the writing of teaching materials for distribution in the district.

School E

The principal in this building reported that two math teachers in his building have what he calls "degree certification in the computer" meaning that they have "probably thirty hours or more in computers" from their college work. Other teachers in the building have taken the district inservice programs and the training programs offered by the Regional Education Service Center. He did not comment on the lack of training during the early years of the program.

The teacher in this building was, however, explicit about the first years. When asked about her training for the first year's teaching experience with the computer, she replied,

Zero! We taught the computer for two years and then finally when [the district teaching assistant] was given her new position, she taught us her class. We at least understood what we
were teaching. Always before we had taught it because the book said you did it this way, and that's the way we did it. We didn't know why. But she would come through and tell us why we were doing it, and why it worked, and it helped.

With regard to the first year she related,

First of all they threw these eleven computers at us, and they said, "You teach it!" And [another math teacher] and I are partners in everything, good and bad. And we looked at each other 'cause we didn't even know how to turn it on. So we got that little PET BASIC book, and we read it, and we tore it apart, and cut and pasted and wrote our own lessons.

School F

The principal in this building reported one of the major problems experienced in implementing the computer program has been "the fact that we're not getting people trained. In my opinion they need to be trained on the software." He related that, in his opinion, to teach programming was conceptually inappropriate at the junior high level. He believed that the use of computers at this level should be restricted to teaching students how to use software programs both for drill and practice in the various academic areas and also for such things as word processing and spreadsheet functions. If the use were restricted to this, teachers would be trained only in the use of the software programs themselves and not in the specific programming functions of the computer.
The teacher in this building indicated that she had taken two computer courses as part of her undergraduate work.

I'm not a self-taught person. There will be a lot of people that have a computer at home, and they've taught themselves everything. I'm not that. I don't have a computer at home. I've taken courses at college. . . . Since then I've been working on my master's in computers. I think I have fifteen hours.

School G

With regard to the first year the computers were in the building the principal remarked, "The first year, teacher training, there was one teacher that had some training."

After that he said about the teacher's inservice, "they had to go through those little short courses and get as much as they could and go back in there and start teaching whatever they had. And they didn't have enough software."

The teacher at this school remembered the first year the computers were placed in the school.

We just knew they were putting them in, and we had to teach them in the eighth grade. I think we got maybe three hours at the most of training. And then we had to go in and teach this. We had no idea what to do. Some teachers had never seen a computer, you know, had never sat down at a computer. We really did not know what to do. We were just kind of making it up on our own. We had bought a book that was mainly written for the PET, and we just started. And we only had one copy of it, so we were having to make out our labs every week, and we really didn't know what we were supposed to be teaching. . . . I did take a computer class when I was in college. That was part of my math credits. Of course, it was on a mainframe computer. I'd never sat down at a microcomputer before.
Since the first year this teacher and others in the building have taken the district courses taught by the district's teaching assistant as well as the computer courses taught for teachers at the local university.

**School H**

Reviewing the first years of implementation the vice principal at this school recounted,

Realizing the need to educate the teachers was our first real problem, in that teachers resented it, because they didn't understand it. And they resented being told "you have to teach this" without having had the time to prepare. It was a panic. They panicked. So I had called the math department who was in charge of computers at that time and the math consultant came out and taught a class after school and we had more than we could handle.

This course continued to be in demand not only by the teachers in this building but also teachers from other buildings and was offered each year until the 1984-85 school year. The course would run from 4:30 p.m. to 6 or 6:30 p.m. once a week for six weeks, and according to the vice principal, it was very well received. They discontinued the classes when the district established a teacher training center with classes being offered not only after school, but also in the summers.

The teacher at this school indicated that she had some college training for working with computers. But she also participated in the district inservice programs. "I have
attended several back when it was new. Everything I could get into."

Student Achievement

The district's formal measure of student achievement for students in the eight grade was the California Achievement Test. For the school years 1978-79 through 1981-82, inclusive, the test was administered in the spring of the school year. However, beginning in the 1982-83 school year through the 1984-85 year, inclusive, the test has been given in October. Table VIII shows the mean of achievement scale scores for the mathematics total for each of these years by school.

### Table VIII

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>593.8</td>
<td>596.1</td>
<td>587.6</td>
<td>603.4</td>
<td>591.6</td>
<td>599.9</td>
<td>N/A</td>
</tr>
<tr>
<td>B</td>
<td>558.5</td>
<td>568.6</td>
<td>566.4</td>
<td>565.8</td>
<td>542.1</td>
<td>554.6</td>
<td>552.2</td>
</tr>
<tr>
<td>C</td>
<td>604.0</td>
<td>611.9</td>
<td>612.9</td>
<td>623.8</td>
<td>604.0</td>
<td>600.3</td>
<td>605.8</td>
</tr>
<tr>
<td>D</td>
<td>601.5</td>
<td>597.2</td>
<td>612.9</td>
<td>608.3</td>
<td>588.4</td>
<td>603.1</td>
<td>601.5</td>
</tr>
<tr>
<td>E</td>
<td>570.5</td>
<td>569.5</td>
<td>577.5</td>
<td>576.8</td>
<td>586.4</td>
<td>577.8</td>
<td>574.2</td>
</tr>
<tr>
<td>F</td>
<td>560.6</td>
<td>580.1</td>
<td>570.0</td>
<td>574.6</td>
<td>567.2</td>
<td>574.4</td>
<td>563.0</td>
</tr>
<tr>
<td>G</td>
<td>589.5</td>
<td>597.0</td>
<td>600.2</td>
<td>587.1</td>
<td>594.3</td>
<td>597.3</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>571.3</td>
<td>578.5</td>
<td>570.4</td>
<td>574.1</td>
<td>577.1</td>
<td>578.9</td>
<td>585.9</td>
</tr>
</tbody>
</table>
Another formal measure of student achievement at the junior high school level is the Texas Assessment of Basic Skills (TABS) administered to ninth grade students in the spring of the year from the 1979-80 school year through the 1984-85 school year, inclusive. Table IX shows the percentage of mastery of the objectives measured by the mathematics subtest. The results are given for each school by year.

<table>
<thead>
<tr>
<th>TABLE IX</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEXAS ASSESSMENT OF BASIC SKILLS (TABS) PERCENTAGE OF MASTERY OF OBJECTIVES MATHEMATICS SUBTEST FOR THE NORTH TEXAS DISTRICT</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>G</td>
</tr>
<tr>
<td>H</td>
</tr>
</tbody>
</table>

Less formal measures of achievement were the observations and impressions of principals and teachers as well
as the attitudes expressed by students. Following are summaries and responses of these individuals when asked to respond to how they think the exposure to computers benefits students.

School A

As far as achievement is concerned the principal at this school said, "the jury's still out" as to whether or not the usage of the computers has resulted in any increase in student achievement. "I don't know. I don't even know in our district, if we've even put together any figures to see if our achievement has come up." He did however indicate that the use of the computer has been a motivation factor for students. Referring to one teacher who was in the beginning reluctant to use the computers and who initially viewed it as a waste of time, the principal said this teacher later "saw a tremendous reaction by the kids that they were really having problems with in class to get them to do things - complete their work and those kinds of things. They saw a motivational pick up with it." This is especially true with the slower students he added, "because unlike a lot of the assignments where they have a lot of frustration and a lot of times don't see a lot of success with it, they get rewarded pretty much through the computer, and they have success with it."
The teacher in this building agreed with the principal that the slower students enjoyed working with the computers. "Even though they're working, it's nice for a change. They don't realize that they're actually benefiting from it." But this teacher would add that all students benefit from using the computers. "The honors class is always asking if we're ever going to use the computers."

The student who was interviewed at this school indicated that although she liked to be able to use the computers, "we really don't learn that much from the computer." She said she mainly just learned "how to use them, and set them up, and learn the different programs... just being familiar with the computer." She said she believed she could learn more if the computers were "scheduled into our class time more and if students could go to the computers "after we finished every unit" for practicing the material they had just covered.

**School B**

Although the principal in this building believed that students benefit from becoming familiar with computers, their usage, and the vocabulary associated with computer usage, he said, "I don't know if kids learn to add, subtract, multiply, and divide, make change, know what date it is on the calendar with using the computer any better than they did before." He went on to add,
I know that to be anti-computer is not the popular thing to be, and I'm not anti-computer. But I can't help but believe that kids learn adequately through normal teaching methods, before we ever had computers and had the tremendous output of money necessary to purchase them and maintain them. And I'm really not just completely sold on the supposed results that are supposed to be forthcoming from this expenditure of money.

The teacher in this building seemed to echo the attitudes of the principal. Although she said the students love to go to the computer lab, she does not view their exposure to the equipment as influencing their achievement in mathematics in any way. Because they are so excited about using the computers, this teacher used the computers as a motivation for the students to stay on task and finish their regularly assigned work. "They love to come so much that I hold it over their heads to entice them." Although this teacher was reluctant to say that the students learn more math from their work with the computers, she did hasten to say that it is of benefit to them. She believes all levels of students benefit, but most especially the honors students. "I mean they catch on quickly. It's wonderful. And most of the regulars do very well."

The student interviewed from this building certainly reflected the student attitudes described by the teacher. "It's my favorite part of math, is going to the computer room. . . . I think everybody likes it. Everybody
complains when we can't go . . . Sometimes it is a lot of trouble moving from one class to the computer room, but it's worth the trouble of moving back and forth." This student believed it is very important for her and her fellow classmates to have opportunities at school to learn about computers and to use them. "Computers might be the center of our future, you know." Although this student had used the computer only in her mathematics class, she would like to use it in other classes.

I think it would be cool if we could do it in history or English. I have trouble with my adverbs and adjectives and all this stuff all sorted out. If we had a computer, even if they were like games that you could play, it still helps you learn as you're playing.

School C

The principal at this school believed that all students who have the opportunity to work with the computers benefit from it. Computer access seemed to be a motivational factor for the slower students and an opportunity for the faster students to advance at their own pace. "They don't have to sit there and wait for the others to catch up with them. They can go on with other programs." He went on to add,

But it's also good for the slower ones because they get a chance to perform on the computers, whereas they probably never would have a chance until they are older and out working. I think they really like them. I think they enjoy them. When you walk by up there and look at them, they're always very intent on what they're doing.
When asked if our effectiveness in teaching with the computers could be measured by the students achievement in mathematics, the teacher responded, "Not really." However, she did go on to add, "In some ways it does help them work on their logic. They're very weak in that at this age."

After further reflection on the question, she did continue to say that the best way to measure the effectiveness of teaching with computers would be to consider student attitudes which she says is very positive in her classes for all levels of students. She would even add that perhaps the basics or the slower students felt the best about it and benefit the most because "they were so starved for something new... They don't have the logic skills... but they were more adaptable than the regular eighth graders." She believed the regular students and more especially the brighter students will somehow get what they need as far as computer instruction is concerned. They will get it in high school or in college courses because they have the motivation and the natural aptitude.

It's the kids who aren't necessarily going to be computer programmers. And yet everything you do nowadays is aided if you are capable of using a computer, not programming it, but using software that is there, if you feel comfortable sitting down at it, if you feel like you know how to load a program, how to run it, how to use. To me that's ninety per cent of the battle. That's the number one advantage of this program.
School D

Although the principal at this school did not believe the students benefited very much from having the computers in the school during the first years "because of the insecurity of the teachers," he went on to add,

I think it's great now. I think as we go along, we'll get better. . . . The program has not evolved and been as successful as I would have liked. . . . I don't think they've used it like they should, as much as they could have.

This principal believed that the special education students and basic students could benefit very much from working with computers because it is a different approach. He said that it holds their attention like the video games they play.

Where the basic kids run into problems in math is doing the math, you know, in their head. Whereas on a computer if they could learn how to put that in there and see the process on the screen, not only do they feel it, the see it. And I wish they could almost hear it. I wish we had a speaking computer where they'd have three different areas of the senses to comprehend a little simple problem. And I think they would learn, because it's just repetition anyway.

The teacher interviewed from this building would agree with the principal in the benefits to the slower students because it holds their attention. She believed that if the software were available to provide drill on the computer as a supplement to classroom instruction, it would help these students increase in achievement. It would also be good for
students who have been absent, but she added that would take a tremendous amount of teacher time. She said their situation was not very conducive to this type of use because the computers were in a separate room. But she would use the computers in this way, and she believed other teachers would also, if they were more accessible.

The other benefit she observed the students receive in working with the computers was the development of logical thinking.

For many people solving even simple problems is just overwhelming. And learning to do very simple computer programs, where you must break every single item down into the tiniest of parts, and learning that there must be a logical flow to the way we put things together, with the incentive of doing it on the computer. . . . I really feel that the logical thinking is going to be our greatest benefit for the overall student.

School E

The principal in this building viewed the use of the computer as much a motivational tool as an instructional tool. Using the computer in this way seemed to be effective with all levels of students. The slower students who used the equipment for drill and practice were encouraged because "it helps to build confidence in them. . . . It allows them to make mistakes without putting them into a depressing situation." Because there are different levels of programs for the student to use, the higher level students seem to
benefit from using the computer at a level which is appropriate for them. "There's got to be the challenge there for whatever level they are. . . . You've got to have it at a level that stretches their limits and makes them do things out of the ordinary that they normally possibly would not do."

The teachers interviewed at this school did not really like the computer unit. They believed that exposure to the equipment is good because many students will never have the opportunity if not at school. They also agreed that the students were excited by the availability and the use of computers, and they capitalized on this in using it "as a motivation for their classes because the kids really want to work so they can get on the computers." However, it was clear from their expression, they felt the academic benefit received by the students in the computer unit was very limited. This appeared to be the result of the small number of computers (eleven) available for use by one mathematics class which may have twenty-eight to thirty students in it.

If the teachers at this school expressed a negative attitude, the student they selected to be interviewed conveyed the opposite sentiment.

This year, mainly the first semester, our teacher took us down to the computer room and taught us the basic things on the computer: how to turn it on, how to do a few commands like clear it, and a few other things. After that I just kind of took it up on my own. I just kept on going because I really liked it.
This student enjoyed the programming aspect of working with computers, and had written a security program to prevent other students from tampering with his work. But he also used some of the "mind games" which were available and believed that they were helpful in practicing such skills as the operations with integers. He said that he and a few other students he knew took every advantage to use the computers at the end of class periods when they finished their work. This student did not have a computer at home but wanted to work during the summer to earn money so he could purchase his own computer. An interest that had been sparked during experiences at schools was causing this student to look forward to future opportunities to work with computers in high school and possibly even as a career. 

School F

The principal at this school was very positive about the use of computers as an instructional tool for students. However, he recognized several situations which handicap the benefits that students received. Limited availability of software, inadequate teacher training both on using the equipment and the software, and the introduction of different types of computers in the schools all resulted in decreasing the potential for student achievement as a result of using computers. Although only a small percentage of the
students in his school had much access to the computer, he viewed the computer as a potential motivator for students. He referred to instructional programs which could be personalized with the student's name and provide positive reinforcement for correct responses. He viewed the use of the computer as being a possible means for reducing student failure rates.

The teacher interviewed at this school taught the computer literacy pilot class offered to seventh and eighth grade students on a one-semester basis during the 1984-85 school year. Prior to that for three years she taught eighth grade mathematics which included the computer unit. In the computer literacy classes the students learned the basics in operating the C64 Commodore computer as well as the use of several software programs: word processing, data management, and spread sheets. In the one semester course seventh and eighth as well as varying ability levels were mixed from the special education resource students to the honors students. Although she modified the curriculum for the resource students, she related that they showed a high degree of enthusiasm. "I have not had one of those children who did not give a hundred per cent." She made a similar comment about the honors students but said there are some of what she calls the "middle" students who just "don't give a hoot what happens and they just don't do." In spite of
this, however, she believed that everyone really benefits from working with the computer.

In commenting on the computer unit for eighth grade mathematics students, she said the focus was really on programming the computer. If the students received any extra instruction in mathematics as a result of the computer unit, it was as a byproduct of the fact that she was a mathematics teacher. "If we were doing fractions, I would probably take them and have them work a program with fractions. Or when we did per cent, they would work a program involving percentages. She said that practicing arithmetic on the computer was more fun for students than pencil and paper drill. "So I used it in an area that would be positive reinforcement of the skills learned."

The student interviewed at this school was one of the special education students in the computer literacy class. He said he was learning how to operate the computer: how to print on the printer, type on the keyboard, and how to use the files. When asked how learning the computer would help him, he replied,

well if you go to computer schools and all that, they'll help you get better jobs for you. And they help you figure out problems better than using your head most of the time.

In addition to his computer literacy class, this student said he had two special resource classes which each made use
of computers. He liked to work on them as much as possible. Describing a program called "Two, Too, To," he says, "it helps you identify all three kinds of 2 - the number two, which is two, there's too much which is 't-o-o' and then there's 'to' like going 'to the store'." He would like to have computers in all his classes. When trying to describe his favorite thing about the computers he said,

Actually everything to me is the best thing, 'cause I like to study about computers; I like to work on them; I like to learn more things about them; I like to study the parts of the computer; and I just like typing on them.

School G

When asked about getting the expected results from using computers for instruction, the principal of this building replied, "Right now, I'm not even sure what we're trying to do." However, he felt it was important to have computers in the schools and teach students how to use them because computers are increasingly more a part of everyday life. He cited walk-in banking, computerized purchasing such as paying for gasoline, and computer generated utility bills as examples.

I think it's a - I don't want to say survival skill, because you can survive without computers - it's I think for any youngster, anyone who's going to be an active participant and live in a sophisticated society like we're probably going to have, is going to have to have some computer literacy skills.

Although he expressed this attitude about the relevancy of
teaching with computers, he believed neither the teachers
nor the students have been prepared to use them effectively.
He said the schools probably would not have had computers if
consumers in the market place had not run the price down.

It never would have been unless the cost had come
down. I think there needs to be a lot more work
done on the hardware selection, the software, and
the training before it's ever put in the schools.
I think what happens a lot of times, it gets to
our schools and they say "OK, there it is. Teach
it." And then people feel responsibility to do
an adequate job, and they feel very inadequate
because of their training or because of lack of
things to tell the kids.

Although the teacher in this building expressed some
serious problems with the eighth grade computer unit in
mathematics, she did believe that all students benefit from
being able to work with computers not only from the
programming aspect but also from the drill and practice
capabilities of the computer.

I really think they all benefit in some ways from
it. . . . All the kids love it, even the
basic [students]. It's just something they
really get excited about. . . . That three
weeks that we're in there, they're never tardy
for class. They're ready to go and they're real
excited.

The student interviewed at this school had a Commodore
C64 at home. (The teacher reported that about half the
students in this school had a computer at home.) Although
this student liked the computer unit and he believed other
students did also, he said it was easy, "sort of a freebe."
He liked the programming aspect of working with computers,
but he believed that using the computer for computer assisted instruction was not that valuable for him. The software programs were too easy.

I don't really think you could get software programs that are at the level — well you could, but the software has very high prices. Then you use it approximately — say we go through a unit like — we go through an algebra unit once every two days. Let's say I bought four for $42.00 each . . . and I used it for two days.

His point was that it would take many software programs for one course, and the cost would be so high that the benefit would not be worth the cost, because the instructional opportunities were available in other ways.

**School H**

The vice principal interviewed at this school was formerly a special education teacher at the junior high school level. With a strong college background in computer science, she had always had a high level of interest in using computers for classroom instruction even for slow or handicapped learners. When computers were first available at this school, she used them in teaching her special education classes, and was very surprised to observe the high level these students were able to achieve.

Since I was teaching math, that was how I brought math in, is that it averaged their grade. It was real exciting for them. And even like I said, it was strange for me in that some of my lowest students, and at that time we had career arts (students that have below 80 IQ), and some of them were my better programmers, which really fascinated me. They were not only motivated,
they stuck with it. They could see, for some reason, the logic when my higher students could not comprehend what was going on.

Although she recognized a special benefit for the handicapped students, she believed the students who would use computers "in their life" benefit the most from computer instruction in the schools.

The teacher interviewed at this school also expressed surprise when she discovered that slower learning students could function very well in working with the computer. "But I used it with basics for remedial, a lot of practice, practice with integers, adding, subtracting." However, the more advanced students benefitted also because they were able to work at their own level with the computer. "The advanced student - I'm trying to let him advance also." She says the students loved to work on the computer and she thought having computers available in the mathematics class helped students to like the math class better. "I like for them to like math." Having computers in all the math classrooms would be the best program, she believed. With this availability the computers could be used as they are needed for drill and practice or as students show an interest for developing programming skills.
Socioeconomic Status of Students

One measure of the socioeconomic status of students was the percentage of students participating in the free and reduced price lunch program. Table X presents this information. The percentages were figured by dividing the average number of students participating in the program by the average daily attendance for each school for each year.

<table>
<thead>
<tr>
<th>Table X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Students Participating in the Free and Reduced Price Lunch Program in the North Texas District</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>29</td>
<td>32</td>
<td>31</td>
<td>29</td>
<td>31</td>
<td>28</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>13</td>
<td>16</td>
<td>15</td>
<td>13</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>F</td>
<td>13</td>
<td>18</td>
<td>12</td>
<td>17</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>G</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>H</td>
<td>9</td>
<td>11</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Another less formal measure of the socioeconomic status of students was the interest shown by parents in the educational programs in which their children participate. To get
some impression of this each principal and teacher inter-
viewed was asked if they ever get any feedback from parents 
regarding the unit on computers taught to every eighth grade 
student. Following are the comments from these people.

School A - The Principal

I think parents—my opinion is that the general 
public consensus is that computers are the thing 
of the future. It's the age of technology, and 
that's the only way to go.

The Teacher

Not much. The first and second year we got them, 
yes. I heard at open house they were real 
pleased. But really not much any more.

School B - The Principal

I get none [feedback] whatsoever from my parents. 
Now, if we didn't have them, I might have 
feedback.

The Teacher

No, I haven't. I know that sounds bad, but, you 
know, we don't have a big turnout for our open 
house.

School C - The Principal

Not a whole lot. But I'm sure the parents espe-
cially out here are probably more aware of the 
need for computers. And I'm sure they are 
pleased with the computer program.
He had complaints from parents of students who will be in the eighth grade in 1985-86 because the eighth grade computer math unit is being dropped. One semester of computer literacy is being added for all seventh grade students. Consequently, students who will be in the eighth grade in 1985-86 will completely miss any exposure to computers in junior high school.

The Teacher

Yes, several of them will buy their kids computers after they've had it up here. A lot of them already own them and are glad to see the kids learning something about them here. All positive. I've never heard any negative feedback from them. They know it's the coming thing.

School D - The Principal

Not in quite a while. I know when we first got them, I know at one of our meetings, two or three of them came up and said how glad they were that we were starting it, on it anyway. But I think since we've had them four years now, it's just a regular part of the program, and they're used to it.

The Teacher

A majority of parents are in favor. I've heard a few parents complain of expense, but very few, and it's gotten less over the years.

School E - The Principal

Yes, and it's interesting right now. I'm probably getting more feedback of concern for this year's seventh grade student who will be going into eighth grade next. And next year's seventh grade students will have a semester of computer literacy, and next year's eight grade will have
just missed it. And they are wanting to know what can we do to get something for those eighth grade students who have just missed the computer literacy program.

**The Teacher**

Most of them think it's really neat that we have them here and that the kids are getting it at school.

**School F - The Principal**

My PTA wanted to sponsor an adult education program after school for parents. One of my computer literacy teachers was going to teach it after school on our computers.

**The Teacher**

At PTA they say their kids love it, but nobody writes me letters or anything.

**School G - The Principal**

In this particular school, our math teachers in a kind of survey [learned that] we probably have a third or more of our kids, maybe half of them, have computers at home. . . . The only thing I hear from parents - I've had several calls on what kind of computers we're going to have next year so they can buy the same thing at home.

**The Teacher**

Most of the ones I've talked to were real impressed that we're even teaching computers at all, of any kind, to these kids. They thought that was very great.

**School H - The Vice Principal**

They're very excited and very frightened. Every year at open house, we have demonstrations with the computers and we invite the the parents at
the general session to be sure and stop by the computer room. Otherwise it would be locked and the lights would be off. So we every year either have the science kids and some of the math kids do demonstrations, and what they'll do . . . and we've always had certain students that have been advanced enough to write their own programs and run them for the parents. So we always have all the computers on with different programs going. We ask the parents to sit down, we have a student available for each computer, and we ask, "Would you like to run this program?" And they get it started. They have a parent do it. And we actually again, can't close out open house because parents are in the room. And we can't get the kids to leave. Little brothers and sisters, you know, they're in there screaming, "Yea!" and "I can't believe this." They really enjoy it. At first they're very apprehensive. They'll come in, and they'll sort of stand at a distance. And we've told these kids that are running the computer room, and we don't have a teacher in there. We want this to be student run. If you can get them to sit down and do one thing, and then they can't get them to quit. So that's generally their first reaction. They stand back because they're not familiar with the computer, and they'll just stand at it. And we'll ask would you like to and they'll say "no, no" and the kids will say "look, watch this". And they get them at least to watch it, and then they really relax. So a lot of the parents are excited once they've been in there. So we try to educate our parents because it's important they know what their children do.

The Teacher

Not really.

Problems

It is possible that the addition of the three- to six-weeks unit on computers into the eighth grade mathematics curriculum could have influenced achievement in mathematics
in a negative way. A number of teachers did express some concerns in this regard. Comments from teachers are as follows:

**School A**

At first they told us that we should teach six weeks of it. We couldn't fit six weeks in our schedule. We did combine some of the material and shorten it so that we could fit in the computers. We teach about three weeks now out of the year. . . . One of our teachers doesn't like it at all, just does not like computers. She'll teach it, but just because she has to. The others who teach it are fair. It's OK. They're glad when it's over, when the three weeks is over. I guess anything that you're not real sure of yourself is hard to teach. I think that's been the problem with that with several different teachers throughout the district.

**School B**

I hate to speak for them [the other teachers], but I think they feel like it is real hard to fit it in with what we need to do in our other classes. One day a week is a lot, and I don't always make it one day a week.

**School C**

We don't have a lot in CAI. We don't have a lot of time. Last year we used those programs a lot more. This year we don't have much time in our curriculum with all the added things from the essential elements.

**School D**

The teacher in this building said (and this was confirmed by the director of instructional computing) that the
eighth grade was selected for the computer unit because it was the last year that forty-five minute class periods were acceptable by state law. Since fifty-five minute class periods were used in the district for eighth grade classes, the rationale was that ten minutes per day could be devoted to computer instruction. If the ten minute periods were concentrated into one unit of study, it could legally last for six weeks. But doing this eliminated some topics from the eighth grade mathematics as it had been taught five or six years ago. Topics that have eliminated are trigonometry, volume, surface area, probability, and statistics.

All the optional topics are gone. And they get much less algebra than they did. We felt it was a real handicap to have it in the eighth grade in our building. . . . We felt that the seventh grade program would have been a better place to put it, because we spend nearly all of the seventh grade year reviewing sixth grade math.

School E

In the eighth grade, and I know a lot of teachers don't agree with me, there's so much to teach them in the eight grade math that I don't have room for this, to take time out and do the six weeks worth of computer literacy. . . . But right now, we're not getting to everything we need to teach this year as it is. And I don't think computers in the eight grade math is the right place for it.

School G

[We teach] just three weeks for the whole year because we can't get all the rest of our curriculum taught if we go back again. . . . It took me from the first day of school to the last day
of school to teach the curriculum as it was before they added the computers in there. And it's really pushed us to get it all taught.

School H

The teacher in this building had not spent as much time on the computer unit during the 1984-85 school year as in prior years. She said there were a number of reasons: the essential elements, this year's group seemed to need more structure and class time, and because of the grade change this year. We're having more dealings with parents, more dealings with failure, because of no more D's. So now, as I said, really now it's several things. It's not just me. It's all the other eighth grade teachers. As a matter of fact, I suppose I've been as much as anyone and more than some.

The other major problems elaborated in previous sections were inadequate teacher training, the small number of computers per student, and the lack of appropriate software.

The director of instructional computing elaborated on the most difficult problem in implementing this program. He said this was the problem of communicating what the program should be to the teachers. He said some of them had difficulty in seeing "how it would work in the context of their class." Every teacher seemed to be different in their attitude about the program, and some were so different that "there was not answer to give to satisfy them. Some people would not accept any of the answers."
He said a fault of implementation of the computer unit in the eighth grade mathematics classes was the lack of "a complete program mapped out ahead of time." A complete program is a necessity "even if it's a bad program." Not having a program leaves open-ended questions that cause some teachers to feel so insecure about the unit that they are very reluctant to try. He said, "when we bought the computers and put them in the schools, we thought everyone would say, 'Oh, boy! Computers!' but the combination of no teacher training, no answers to the open-ended questions, and no preplanned program caused a number of problems." He went on to say that these problems in the junior high program helped to shape the planning and implementation of other programs added at the elementary level in the school district.

ANALYSIS

The West Texas District

As Kiesling (3) noted, the expending of funds is not a treatment and should not be so considered. On the other hand as Averch (1) suggested, instructional resources are not free, and policy makers frequently find themselves in the position of determining not whether a particular resource should be purchased but how much of that resource should be purchased. Over the three year period from 1982
to 1985 the west Texas district spent approximately half a million dollars for a computer-assisted instruction program intended solely for the purpose of remediation for junior high school students who were behind in grade level achievement in English and mathematics.

The consensus of opinion among teachers and principals interviewed was that the program was adequate to serve all the students in one grade level who needed the program. That is to say, there were enough computer terminals, software materials, and supplies to provide each qualifying student in one grade level with approximately half a class period or twenty minutes a day of one-to-one interaction with the computer in either English or mathematics or both. Some principals made double use of the computer lab facility by scheduling two groups of students through the lab each day. Figure 2 charts the percentage of students who used the facility each day during the 1984-85 school year. The variation appeared to be based more on the result of management practices of the principals than on predetermined need. Percentages include both English and mathematics classes.

The half million dollar figure mentioned earlier was a total for three years; an average cost per year is approximately $167,000. In the 1984-85 school year the program served approximately 784 students, resulting in a cost per
Fig. 2.—Percentages of students using the CAI lab each day in the 1984-85 school year in the west Texas district.
student of roughly $200. As a measure of cognitive achievement this school district used the Metropolitan Achievement Test administered in the semester year to students at each grade level. Figures 3 and 4 chart the achievement levels for each junior high school on the mathematics subtest of that instrument for ninth grade and seventh grade students, respectively. It should be noted that the testing dates for 1981-82, 1982-83, and 1984-85 were in late January, and in 1983-84 the testing date was early in April.

The 1982-83 school year was the first year the computer-assisted instruction program was used in every junior high school. Since the district owned some equipment from prior years, two schools (A and B) had the program running at the beginning of the school year using the previously purchased equipment. However, delivery and installation delays slowed implementation in the other four junior high schools, and students did not have access to the equipment until sometime between November and January of the school year. The classes were in place and instruction was ongoing in these schools, but without the computers. But by the 1983-84 school year, all equipment was in place, most teachers had some experience with it, and qualifying students had access to it for the entire school year. During these two years the target population was ninth grade students. Figure 3 shows that for the 1982-83 school year
The 1982–83 and 1983–84 school years the computer assisted instruction program was used for ninth grade students.
The 1984-85 school year was the year the Academic Skills class was implemented in the seventh grade.

Fig. 4.—Achievement levels for seventh grade students in the west Texas district.
measured cognitive achievement rose from the prior year in three schools (A, B, and C) and declined in three schools (D, E, and F). All schools show an increase in achievement in the 1983-84 school years, and all but one school shows a decrease in the 1984-85 school year. This is probably the result of the testing date in 1983-84.

It was in this last school year 1984-85 that the computer-assisted instruction program called Academic Skills was moved to the seventh grade in every junior high school. The consensus of opinion by the district coordinator, the principals, and the teachers was that the program would be more appropriate for seventh graders. As one principal put it, "we feel we can help the seventh grader more than we can the ninth grader." About using the program with ninth grade students another principal commented, "they're so far behind and so diverse in ability that we couldn't pick them up."

Figure 4 charts the measured achievement levels of seventh grade students over a four year period for each junior high school. In four schools the achievement levels declined and in two schools the achievement levels increased from the year prior to the year the Academic Skills classes were introduced into the seventh grade curriculum. Again, the testing date for the 1983-84 school year should be considered.

Every writer on school effectiveness since Coleman (2) recognizes the significant variation in achievement relative
to the socioeconomic status of pupils. It was in the spring of 1982 that this school district came under a court ordered desegregation plan, and bussing to achieve a racial balance was implemented. As a result, school district boundaries were changed in the summer of 1982, and the 1982-83 school year saw shifts in student populations from prior years. It was also at the same time that a tri-ethnic committee was established by the board to study and make recommendations on, among other things, the maintenance of racial balance in the schools.

In this study the formal measure of socioeconomic status was the percentage of students participating in the free and reduced price lunch program. Data by grade level was not available in this school district, but it was obtainable by school. Figure 5 plots this information for a four year period. Although three schools (C, D, and F) show an increase, two schools (B and E) show a decrease and one school (A) shows no change from 1983-84 to 1984-85, all the changes except one are slight with only a few percentage points in difference. More change is noted from the 1982-83 to the 1983-84 school year where five schools show an increase and one school shows a decrease. Overall, economic deprivation over the four year period tends upward.

These changes in socioeconomic status could have implications for the achievement information presented earlier.
Fig. 5.—A formal measure of socioeconomic status of students in the west Texas district.
When adjusting somewhat for the achievement peaks in 1983-84 which may be partially the result of the testing date being more than two months later in the year, achievement is still tending upward for most schools at both grade levels. The expectation is that achievement will decline when economic deprivation increases and vice versa. However, both for the ninth grade students in the 1983-84 school year and the seventh grade students in the 1984-85 school year some mediating factor or factors influenced the actual results, and the expectation was not realized. A possible explanation is that the Academic Skills classes were a good and appropriate intervention and actually contributed to an overall increase in measured achievement. In examining the peaks in achievement which occurred in 1983-84 for both the ninth and the seventh grades, the peaks for the ninth grade seem to be higher than those for the seventh grade, relatively speaking. It is possible that the Academic Skills classes may have had a greater impact at that grade level than the teachers and principals thought. Perhaps working with a different instructional medium, the computer, which provides positive feedback to students discouraged from many years of failure, is highly motivating at the ninth grade level.

Another certainly less formal but nonetheless important measure of socioeconomic status of students is the amount of interest parents exhibit in the educational activities of
their children. Figure 6 gives a matrix summary of the perceptions of the principals, teachers, and students interviewed regarding how the parents feel relative to the Academic Skills classes. Most principals and teachers said they got little or no feedback from parents regarding any school program including the Academic Skills class. However, four of the six students when asked if they ever discussed their CAI class at home indicated that they did, and their parents were pleased that the children had this opportunity. School D where both the principal and the teacher reported a high degree of interest from the parents regarding the Academic Skills classes, showed a good overall level of achievement when compared to the other schools. The principal at School D when asked if he ever got any feedback from parents said, "Yes, a lot of them want to put their kid in it. . . . It has a positive image here." Although the principal at School B said he got very little response, apparently he got a good turn-out at open house each year when the parents were invited to tour the building, visit classes, and talk with teachers. He observed that many of the students in the CAI classes took their parents into the computer lab for a demonstration. He related, "They go in there, and they [the students] start the machine. The kid shows the parents, and they smile."
PERCEPTIONS OF PARENT ATTITUDE
(IN TERMS OF FEEDBACK FROM PARENTS)
REGARDING ACADEMIC SKILLS CLASSES

<table>
<thead>
<tr>
<th>School</th>
<th>School</th>
<th>School</th>
<th>School</th>
<th>School</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>Principal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Teacher</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Student</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>

+ indicates positive responses
- indicates negative responses
0 indicates either neutral responses or responses that were neither obviously positive or negative.

Fig. 6.—Perception of Parent Attitude in the West Texas District

Although the standardized achievement test is a measure of cognitive achievement, a measure of noncognitive benefit is more elusive but nonetheless significant because the way students feel about school in general influences the cognitive benefits they receive while in attendance. During each interview principals and teachers reported their impressions regarding the benefit students received from the participation in the CAI program. Five of the six principals and likewise the teachers reported their belief that it helped the students who were enrolled in the program. Furthermore, the benefits received covered a range of advantages from academic progress to improved status with their peers. For students who have "lost their drive in trying to learn with
the regular teacher" students in the Academic Skills classes had a different environment using recognizably current and fascinating technology. Students experienced a motivational factor and more individual attention missing from regular classes which were also larger. One teacher reported the pride that a student had when she progressed five grade level equivalencies in one year in the Academic Skills class. Only one teacher reported that he believed the classes did not benefit the students. With two Academic Skills classes he reported that none of his students had come up to grade level achievement in mathematics, and as a general rule he believed his students did not benefit from the program.

The students were unanimous in their positive attitude to the CAI program. They said, "it's fun, it's nice." When making a mistake with a problem, "you get a change to try again." One student reflected, "I like it a lot. It seems to help me. When I work, it puts me in my own world or something. Don't nobody be bothering you." Still another student commented, "Some kids call us lucky because we get to work on computers and stuff." The students were also asked how they thought the other students felt about the program. Several conceded that some students liked it, and some did not. One girl noted that some of the boys thought it was boring. Another student noted, "Most of them think
it's OK. Most of them think it's sorta not OK 'cause they know most of the time they don't get most of the problems right. They get a low score. . . . Most of the people don't like to work on it 'cause they don't act right."

Figure 7 shows a matrix summary of expressed attitudes.

<table>
<thead>
<tr>
<th>TONE OF COMMENTS REGARDING BENEFITS RECEIVED BY STUDENTS FROM THE ACADEMIC SKILLS CLASSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>Principal</td>
</tr>
<tr>
<td>Teacher</td>
</tr>
<tr>
<td>Student responding for self</td>
</tr>
<tr>
<td>Student responding for other students</td>
</tr>
</tbody>
</table>

+ indicates positive responses
- indicates negative responses
0 indicates either neutral responses or responses that were neither obviously positive or negative.
+/- indicates both positive and negative responses.

Fig. 7.—Responses on noncognitive benefits of the CAI program in the west Texas district.

The interviews were conducted in May of the school year and most of the students who were in the Academic Skills
classes had been in them for the entire school year. This is the time of the year when students are typically tired of school and eager for summer vacation. Some of the negative responses could have been a reflection of this. However, it could also have been the results of some problems reported by the teachers and principals. There were two major problems consistently reported, either one of which could have had a significant impact on the program. One is downtime associated with equipment and software troubles.

Schools A and B both used the mini-computer located at School A. The teacher at School A acted as the technician and operator of the computer. If either school experienced a problem, he had to take time out of his classes to trouble-shoot the problems. The teacher at School B reported approximately three weeks time lost to such difficulties during the school year. Schools C, D, E, and F all used a computer located at a high school. Consequently, no one teacher at any of these junior high schools lost class time as a trouble shooter. However, the equipment and software for these schools was newer and seemed to have more "bugs" than the older equipment used at Schools A and B. As a result they reported a considerable amount of downtime also. In addition to the loss of time, the flaws in the software apparently caused the computer to respond inappropriately to correct responses from the students.
This seemed to be a discouraging factor to students. One teacher commented,

And when you have students complaining constantly that the computer's messing up, "I punched the right answer and it counted it wrong," and they will ask me to come back and look. And I'll look and they'll tell me what the answer is and I'll say, "That's right."

The other major problem reported by the teachers was what one of them called "burn out" with the routine. Each student was required to complete two, ten-minute lessons on the computer each day. Furthermore, many students had Academic Skills classes for both their English class and their mathematics class. Several teachers noted that by mid-year some students were beginning to complain about the regimen. Three teachers commented that they invented games and contests to keep student interest alive, and that they rewarded the winners with candy. On teacher reported, "I started getting complaints right after Christmas. And I started rewarding with candy, and the number of complaints went down accordingly, and it has continued to decline to the point that now I'm not having any complaints."

One intervening variable which some teachers complained about but which seemed not to have a negative impact on the program was teacher preparation for working with the computer terminals and the software. The complaints may have been more a reflection of initial apprehension or fear of
working with unfamiliar equipment. Apparently, the equipment and software were easy for most teachers to use. Some teachers taught themselves from the manuals, others learned from another teacher in the building or by attending the district inservice workshops. Regardless of the comments, all teachers interviewed seemed comfortable with the equipment. The district coordinator reflected upon this point.

The hardware shock does get some of them. But when they find out that their main job is to guide instruction, and that the system takes care of itself, and they just need to keep records and know where the kids are and know what's taught in that area, they don't really have to be concerned with trouble shooting the hardware, they don't have near as much anxiety.

Summary for the West Texas District

During the school years from 1982-83 to 1984-85, inclusive, the west Texas district used a computer-assisted instruction program called Academic Skills for the purpose of remediation in mathematics and English for students who were two or more years behind in grade level achievement as measured by the Metropolitan Achievement Test. In 1982-83 and 1983-84 the targeted population was ninth grade students, and in 1984-85 it was seventh grade students. For the three year period the cost to the district was approximately half a million dollars. This figure included expenditures for equipment and software rental, maintenance for both owned and rented equipment, and for supplies.
Using approximate numbers of students served by the program, the cost per student was estimated to be two hundred dollars.

The Academic Skills program consisted of a computer-driven drill and practice program with which students interacted on a one-to-one basis with the computer via terminals located in a classroom at each of six junior high schools. The computers, terminals, and software programs were leased as a commercially prepared package from the Computer Curriculum Corporation. Each student's program of study was individually prescribed after either a computer analysis or a teacher analysis of the child's level of achievement. Replacing the student's English or mathematics class, the courses known as Academic Skills/English and Academic Skills/Mathematics, were full year courses with fifty-five minute class periods. Students assigned to the classes received thirty to thirty-five minutes of classroom instruction from the teacher in a group situation and twenty minutes of individual practice on the computer each day. The principals had the option of scheduling the classes in the room where the terminals were located or scheduling the classes in another room, allowing the students to move into the computer room only for the twenty minute period required for computer practice. If the principal chose the latter, twice as many students in the school had access to the
program. The principals at schools A, B, and D followed this practice in the 1984-85 school year. However, measured achievement in these three schools was not higher than that of the other three schools which did not follow this practice.

In addition to the number of students having access to the Academic Skills classes, another factor which could possibly influence achievement was the preparation of the teachers in using this computer-assisted instructional program. Although some teachers admitted that they had been uncomfortable in the beginning and had no prior training in using computers for instruction, all the teachers interviewed seemed to be in complete command of the situation, technically speaking. The district coordinator pointed out that it was an easy system to learn, one that would "run itself," and what the teacher primarily had to do was to guide instruction. Planned inservice offered by the school district and building level coordination among the teachers in helping each other seemed very adequate to provide all individuals with the training needed to teach the classes. All teachers and principals seemed to have a good understanding of the goals and objectives of the courses, and these were implemented uniformly throughout the district.

Measured achievement in most cases did not follow expected patterns. Using the number of students
participating in the free and reduced price lunch program as a formal measure of socioeconomic status, it would be expected that achievement patterns would have an inverse relationship to socioeconomic patterns over a multiyear period. When considering the data for ninth grade students in 1981-82 and 1982-83 this pattern is consistent, i.e., the schools high in achievement are low in percentage of disadvantaged students and vice versa. However, in the 1983-84 school year all schools (except one) increased in the percentage of economically deprived students but at the same time also increased markedly in achievement. Some of this increase can be attributed to the fact that the test was given two months later in the year, but even adjusting for this, achievement went up at a time when economic deprivation also increased. The 1983-84 school year was the one full year of implementation of the Academic Skills classes in the ninth grade. In the 1984-85 school year the program was moved to the seventh grade level because most principals thought it would do more good and be more appropriate at that level.

Considering the comparisons of the two measures of achievement and socioeconomic status for seventh grade students, the patterns were mixed. Although schools generally high in achievement were low in economic deprivation and vice versa, there were some unexplainable changes from one year to the next in this relationship. One thing
can be noted, however. Achievement in 1984-85 declined in four schools and increased slightly in two schools from the prior year while the percentages of economic deprivation changed only slightly. This decline might not have occurred if the testing date for 1983-84 had been in late January rather than in early April. Adjusting for this, achievement is still tending upward for five schools at the seventh grade level beginning in the 1982-83 school year. The 1984-85 school year was the year the Academic Skills classes were dedicated to the seventh grade students.

Although all students interviewed believed the computer-assisted program to be valuable for themselves and generally speaking for their classmates also, many teachers indicated that students tired of the routine. Many of the teachers labeled this problem "burnout" on the part of the students. Although many teachers met this challenge and seemed to be able to devise schemes to help students overcome this problem, it is possible that it could have been a factor in the effectiveness of the program.

The North Texas District

In the north Texas district the use of computers for mathematics instruction evolved over a five year period during the school years from 1980-81 through 1984-85. Beginning in the first year with only three computers in each of three schools, the program developed to include a
mathematics lab in each school with the number of computers ranging from a low of eleven in one school (E) to a high of seventeen computers used for mathematics in each of three schools (A, C, and D). Schools B, F, G, and H had fourteen computers each by the end of the fifth year. This variation occurred as a result of individual decision making in each of the schools. Equal numbers of computers were purchased for each of the schools for use by the mathematics, English, and reading teachers. However, the teachers in each building worked together to varying degrees to combine equipment in a central location for use by all three departments.

The total cost of this equipment including costs for supplies and maintenance was approximately $113,000. This figure includes only those costs which were either originally or eventually dedicated to instruction in mathematics. Although there was some ambiguity in the first two years at which grade level the instruction with computers would be targeted, for the last three years the unit on computers has been used almost exclusively with eighth grade students. The objectives for the unit of instruction were to teach programming skills with applications in mathematics computation; the goals of the school district were to increase achievement in mathematics and to familiarize students with computer technology. Although each school was furnished
with some mandatory guidelines, implementation of the program was somewhat different in each school. The length of the unit of study for example varied from three to six weeks in each school depending upon the emphasis each teacher wanted to place on the unit. Also adding to the variation from school to school was the number of computers available for use by the mathematics teachers. Taking these two variables into account student access to the computer was different in each school. Figure 8 is a graphic display of the number of hours per year that each eighth grade student in each school had access to a computer for individual use, the number of hours ranging from just over six in one school (G) to approximately fifteen hours in each of two schools (B and F).

The formal measure of achievement used by the north Texas district was the California Achievement Test (CAT) administered to eighth grade students. Figure 9 gives a graphic display of the mean of the total mathematics scale scores for each school for the years 1978-79 through 1984-85, inclusive. The total math scores are displayed because of the belief of some of the teachers that the computer unit strengthened the development and problem solving ability as well as the computational skills. For the four years from 1978-79 through 1981-82 the district administered the test in the spring of the year. However, for the years
ACCESS TO COMPUTER LAB
EIGHTH GRADE STUDENTS

Fig. 8.—The number of hours per year students participated in the eighth grade computer unit in the north Texas district.
Fig. 9.—Achievement levels for eighth grade students in the north Texas district.
of 1982-83 through 1984-85 the test was administered to eighth grade students in the fall of the year. Since this break in testing procedures inhibits the detection of patterns in achievement across the break, data was also collected for the mathematics subtest of the Texas Assessment of Basic Skills administered to all ninth grade students in the district in the spring of each year since the 1979-80 school year. The rationale for consideration of this data was that scores on the test reflected student achievement from prior years. Although individual schools show up and down variation from year to year (see Figure 10), the general trend for the district as a whole is upward with the scores in the 1979-80 school year falling between the extremes of 82 and 92 per cent mastery and steadily increasing through the years to extremes of 92 and 99 per cent mastery in the 1984-85 school year. Schools B and F were the schools which showed the highest number of hours of student access to computers. Achievement for School B on TABS peaked in the 1982-83 school year, and achievement for School F rose steadily from 1981-82 through 1984-85. School G, the school with the least number of hours of student access from Figure 8 also showed a steady increase in achievement on TABS from 1980-81 through 1984-85.
Fig. 10.—Achievement levels for ninth grade students in the north Texas district.
Other less formal measures of student achievement were the benefits received from other higher cognitive and non-cognitive aspects of the program as perceived by principals, teachers, and students. Principals, teachers, and students were asked to elaborate on how they believed students benefited from the unit of instruction with computers. Several individuals volunteered their opinion that they did not believe the computer unit influenced measured achievement in any significant way. However, almost all the principals and teachers interviewed expressed the opinion that the possibility of working with the computers was highly motivational for all levels of students. The students seemed to look forward to the work with computers and to be disappointed if the opportunity failed to materialize. One student said, "Everybody complains when we can't go," and one teacher confessed, "They love to come so much [to the computer lab] that I hold it over their heads to entice them" to do their regularly assigned work. Another teacher indicated that during the computer unit students were all on time to class with all their required materials. She said, "We required them to have a spiral [notebook] . . . and the first day we went to computers, I bet all but maybe two of our students had their spirals."

Not only was working with the computer a motivational factor perhaps lacking in some of the other more routine
aspects of instruction, but also one principal pointed out the potential for individualizing instruction with the computer. About the more advanced students he noted, "They don't have to sit there and wait for the others to catch up with them. They can go on with other programs." Another principal commented that using the computers was good for the slower students also because it holds their attention. Furthermore making errors while working with the computer was less intimidating for the slower students because of the individualized nature of the process. Others expressed the view that learning about computers was an important survival skill in today's technological society. One principal pointed out the use of computerized purchasing and billing as an example of how the computer has invaded everyday life, and a student commented, "Computers might be the center of our future, you know." Figure 11 summarizes the perception of student benefit as viewed by principals, teachers, and students.
TONE OF COMMENTS REGARDING BENEFITS RECEIVED BY STUDENTS FROM THE COMPUTER UNIT OF STUDY

<table>
<thead>
<tr>
<th></th>
<th>Principals</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>+/-</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+/-</td>
<td>+/-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

+Indicates positive attitudes expressed
-Indicates negative attitudes expressed
+/-Indicates both positive and negative attitude expressed.

Fig. 11.—Responses on the noncognitive benefits of the computer unit in the north Texas district.

Relating the achievement and perceived benefits to some measure of socioeconomic status is an important part of any research project. The north Texas district collected and saved data on the number of students participating in the free and reduced price lunch program on each school campus. Figure 12 gives a graphic representation of the information for each of the eight junior high schools involved in the study for the school years 1979-80 through 1984-85, inclusive. This chart reveals a rather stable participation over the years for all schools except possibly for School F which shows more erratic variation than the other schools. The chart fairly clearly divides the schools into three levels of participation: Schools A, C, D, and G have a low
Fig. 12.---A formal measure of the socioeconomic status of students in the north Texas district.
percentage of disadvantaged students with participation ranging from 2 per cent to 8 per cent; Schools E, F, and H have a higher percentage of disadvantaged students with participation ranging from 9 per cent to 22 per cent; and School B had the highest percentage of disadvantaged students with participation ranging from 26 per cent to 32 per cent over the six year period.

Comparing Figure 12 to the achievement charts in Figures 9 and 10 reveals similar grouping patterns for most schools. For example Schools A, C, D, and G are in the high achieving group in Figure 9 and the low disadvantaged group for Figure 12. The same comparisons can be made for the middle group of Schools E, F, and H and School B which is low in achievement and high in the percentage of disadvantaged students. Somewhat similar comments can be made of the comparisons between Figure 10 and Figure 12, but they are not as obvious and do not fit the pattern as well. For example School D shows a peak in achievement in 1981-82 and a sharp decline from that year until 1983-84 where the direction changes to a higher level in 1984-85. However, participation in the free and reduced price lunch program remains low and very stable during those same years.

Although grouping patterns are similar when comparing Figures 9 and 10 with Figure 12, other patterns are not similar and in fact are contradictory. For example in
Figure 9 Schools B and F show peaks in achievement in the 1983-84 at the same time these schools are showing peaks in free lunch participation. On the other hand School E follows expected changes when comparing Figures 9 and 12, i.e., in Figure 9 when free lunch participation increases from 1982-83 to 1984-85 achievement decreases during those years. It should be noted, however, in making these comparisons that percentage changes are very small in most cases, and possibly, congruency might not be expected.

Another measure of socioeconomic status of students is the extent to which parents show interest in the school work of their children. In the interviews conducted at each junior high school principals and teachers were asked if they ever get feedback from parents regarding the instructional unit with computers. Similarly, students were asked if they ever discussed their work with computers with their folks at home, and if they did, how did their parents feel about it. Figure 13 provides a matrix of the perception of parent attitudes as viewed by the principals, teachers, and students interviewed. Most of the responses were positive with only three responses which were either neutral to the question or neither obviously positive nor negative. The principal at School B although emphatic that he never received any feedback from parents with regard to the program, was quick to add that he might have complaints from
the community if he did not have the program. At least two staff members interviewed indicated that they had gotten phone calls from parents wanting to know what kind of computers the schools were buying so they could purchase the same brand for their children to use at home. Three of the students reported that they already had computers at home, and four more students indicated that they wanted to have a computer at home. One eighth grade student interviewed said that he was going to get a summer job so that he could earn money to purchase his own computer.

PERCEPTION OF PARENT
(IN TERMS OF FEEDBACK FROM PARENTS)

| Principals | + | o | + | + | *** | + | * | + |
| Teachers   | + | o | **| + | + | + | + | o |
| Students   | ***** | ***** | o | **** | **** | *** | *** | **** | ***** |

Schools

+Indicates positive response
-Indicates negative response
0Indicates either neutral responses or responses that were neither positive nor negative.

*Parents were buying home computers for their children.
**Concern about children not getting enough computer instruction at school.
***Had a computer at home.
****Wanted a computer at home.

Fig. 13.--Perception of parent attitude in the north Texas school district.
There were three major problems which could have significantly influenced the successful implementation of the computer unit in the eighth grade mathematics curriculum. They were inadequate teacher training, insufficient number of computers in each school, and the attitude of the teachers regarding the placement of this program in the eighth grade mathematics curriculum. The report of these problems was very consistent among all individual staff members interviewed. Unlike the situation in the west Texas district where the implementation of the program was less dependent upon the technical ability of the teachers, the teaching of a three to six weeks unit in the north Texas district which included teaching computer programming was highly dependent upon the skill of the teachers who were directing instruction. Although the teachers rose to the occasion by enrolling in university courses, participating in after school workshops, and teaching themselves on their own time both during the summers and in the evenings, there was no doubt that this initial handicap influenced the beginning years of the program in a serious way.

Another serious and discouraging factor to both teachers and students was the inadequate number of computers in each building available for student use. Although some schools made the most of a bad situation by combining computers originally purchased for the separate programs of
reading, English, and mathematics, this still only resulted in a maximum number of seventeen computers to be used by as many as thirty students during one class period. The problems of doubling up on a computer, or trading off after fifteen or twenty minutes caused frustration, disruption, and lack of continuity to the program. It also resulted in very limited access by students to the computers. The number of hours of access per student ranged from six to fifteen hours per year in the various schools. Considering that a student spends 1225 hours in school in one year, this resulted in a range of .05 per cent to 1 per cent access to a computer during the year. This was hardly a program which could be expected to have much impact upon student achievement.

The third major concern expressed by the teachers was the placement of the program in the eighth grade mathematics curriculum. Several of them indicated that the curriculum was already full before the addition of this unit and that topics had to be eliminated in order to make room for it. As a result of this attitude some teachers devoted only a minimum of time to the computer unit. Also some teachers scheduled the use of the computer lab on an erratic basis of a day every week or two which decreased retention of skills learned and contributed to a general lack of continuity of the program. It was also argued by some teachers that the
elimination of some material in the eighth grade curriculum in order to make room for the computer unit could have actually resulted in a decline in measured mathematics achievement for some students. The reduction in the amount of time available to teach the pre-algebra material was cited as an example by one teacher.

Summary for the North Texas District

Implementing a program which evolved over a five year period from 1980-81 through 1984-85, inclusive, the north Texas district designed a computer unit targeted for all eighth grade students in the district. The formally stated purpose of this program as specified in the district's five year plan was to increase achievement in mathematics. Another less formally stated, but nonetheless deliberate goal of the program, was to provide all eighth grade students in the district a suitable circumstance to learn about and use computers. This experience would include both opportunities to learn simple programming and to use the computers as a tool for computer-assisted instruction in the mathematics classroom.

Purchasing Commodore computer equipment over a period of four years, the district ultimately spent a total of about $113,000 on computers and computer-related expenses
used by the mathematics departments in the eight junior high schools which participated in the study. Over the five year period there were approximately 11,000 eighth grade students who participated in the computer unit. This resulted in a cost per student of just over ten dollars.

Student access to the computers was very limited, more so in the early years of the program since additional equipment was purchased during each of the years prior to the 1984-85 school year. In several of the schools the English and mathematics departments combined their individual allotments of computer equipment and designated a computer lab to be used by both departments. This resulted in a larger ratio of computers to students and gave individual students more time on a computer. Other schools, however, did not do this, and as a result as many as three students would be assigned to a single computer during a class period. This circumstance, together with the length of the computer unit which ranged from three to six weeks depending upon the emphasis each teacher wanted to place on the unit, resulted in very limited exposure to computer equipment by most eighth grade students. An exception to this was found in every school as teachers reported incidences of individual students who became fascinated with the computer and found time on their own to work with the computer and expand upon the introduction to computers received in the classroom.
Since one of the purposes of the computer unit was for students to acquire some programming skills, teachers were required to learn to program the computers. Most teachers reported that when they were first required to teach the unit, they had no prior experience or training in their use. This resulted in a high degree of frustration and anxiety for most teachers. They found themselves faced with a set of computers and a classroom full of students eager for the chance to work with the computers, and no training, experience, or even instructional materials with which to work. The teachers, however, rose to the occasion, some teaching themselves, others taking university courses, and still others participating in district and regional service center inservice programs. They worked summers and evenings preparing curriculum guides and learning packets for students. By the end of the five year period, the teachers were in charge of the situation and for the most part were feeling good about their participation in it.

As an intervention program which might have some impact upon measured student achievement, no evidence found. Achievement patterns generally followed expectations with schools showing high achievement also exhibiting low percentages of disadvantaged students and vice versa. However, when examining noncognitive indications of student benefits to their exposure to the computer unit, evidence was found
to support this. Interviews with principals, teachers, and students revealed a high level of enthusiasm and interest in this program on the part of the students, and this included all levels of students from special education students through gifted students. All reported the possibility of using the computers as highly motivating to students. There were also indications that parents supported the program, by showing interest in reinforcing the school activity by purchasing home computers for their children, and by expressing disappointment with the limited nature of the school program.
CHAPTER BIBLIOGRAPHY


CHAPTER V

SUMMARY, FINDINGS, IMPRESSIONS, IMPLICATIONS AND RECOMMENDATIONS

Summary of the Study

For many years researchers have tried to significantly link expenditures for curricular programs to student achievement. The motivations for these studies have varied. Among these have been the search for inequality in the nation's schools, school finance reform movements, and a general undercurrent of popular opinion that costs for schooling have been increasing while the corresponding student achievement levels have declined. Since these factors have a meaningful impact upon policy decisions affecting schools, research studies to support the effectiveness of schools have flourished. Although researchers have failed to show a positive relationship between school resources and their corresponding costs and student achievement, most researchers have implied that the reasons no significant links have been found have been the result more of inadequate research techniques than of lack of relationship. Many of these researchers have called for further studies which use more sensitive measures of student achievement and which include more than just the lower cognitive measures when assessing achievement.
Recognizing that there are many factors which influence both expenditures and achievement, it was the purpose of this study to investigate the relationship between expenditures for computer equipment, software and other related costs, and achievement in mathematics at the junior high level. This topic was selected because it afforded a fresh opportunity to study an old problem. The extensive purchases of computers for classroom instruction is a recent phenomenon. Rapidly expanding consumer markets have driven down prices to the point where this new technology is now affordable to public schools. Also, public opinion not only encourages but also supports the use of this technology in the schools even at a significantly high cost. Using data from a multiyear period which included years during which computers were not purchased and used for classroom instruction and years in which they were extensively purchased and used, this study sought trends and patterns both in costs, in achievement, and in various mediating factors which influence achievement. Some of these factors were: variances in computers and software being used, objectives of computer instruction, teachers preparation in the use of computers as instructional tools, the amount of time individual students had access to a computer during the school year, and the socioeconomic status of students in the schools using computers for instruction.
In an attempt to overcome some of the problems mentioned by previous researchers in this area, a qualitative research design was used. In particular, a case study plan was applied using two school districts in Texas as subjects. Each school district was ranked as one of the twenty-five largest school districts in the state, and both had used computers for instruction in mathematics at the junior high school level for three or more years. Not only were various types of data collected but also data from various sources were gathered. The types of data included numerical information regarding expenditures, measured achievement on standardized tests, and the numbers of students participating in the free and reduced price lunch programs, as well as data collected from observations during visits to fourteen junior high schools and interviews with teachers, principals and students in each of those schools. The purpose of the interviews, which were accomplished using focused interview schedules, was to uncover information not obvious from studying numerical information solely and to gain understanding of not only the school programs but also to determine the attitudes and impressions of the people involved in those programs.

The data were analyzed using the procedures outlined by Miles and other qualitative researchers. After transcribing the tapes from the interviews and expanding the field notes
taken during the visits in the school districts, the data were categorized using codes which emerged not only from the research questions but also from obvious but unexpected repetitions in the content of the transcriptions. Data were displayed using charts, graphs and matrices, and comparisons were made between the data in the coded transcriptions and the numerical data which were gathered. The use of multiple types of data and data gathered from various sources provided for triangulation of findings. The use of many direct quotations from the individuals interviewed as well as the graphic display of numerical data provides any reader with the opportunity to validate the findings of the study and to confirm the reliability of the work.

Findings and Tentative Explanations

During the school years between 1982-83 and 1984-85, inclusive, the west Texas school district implemented a computer-assisted instruction program which was commercially prepared by the Computer Curriculum Corporation. The program which was complete with mini-computers, sixteen terminal remote labs in each of six junior high schools, software, maintenance, and inservice training for teachers was used for the purpose of remediation for students who were two or more years behind in grade level achievement as measured by the Metropolitan Achievement Test administered
each year to all students in the district. For identified students the program took the place of English or mathematics or both for one school year. In the first two years of the program it was used primarily for ninth grade students. However, in the 1984-85 school year it was moved to the seventh grade where it was believed it would have greater benefits for students. During the three year period the district spent about half a million dollars for lease of equipment and software, for maintenance, and for supplies. Considering the approximate number of students involved in the program, the cost was about two hundred dollars per student.

If there were a direct relationship between dollars spent and achievement, the expectation would be to find a positive link between these two factors in this school district. However, other components in the school and at home influence achievement, and it would be inappropriate to overlook these. In reviewing the objectives of the program, it was obvious that the objectives were clear, understood by all levels of the personnel including the students, and that the objectives of the program were attainable. For the students involved in Academic Skills/Mathematics as the computer-assisted program was called, the objectives were to improve grade level achievement in computation and in the solving of word problems. To accomplish the objectives the
students were provided with about thirty minutes each day of group instruction by the teacher where a group consisted of a maximum of sixteen students, and they also did two, ten-minute lessons at a computer terminal. The lessons on the computer were drill and practice sessions individualized for each student's level of accomplishment. The only hindrances the students ever faced with this one-to-one daily access to the computer were occasional periods of "down time" when repairs or "rebooting" activities with the computer made it unavailable for student interaction. Although some teachers viewed this as a major problem, most teachers and principals thought of it more as a nuisance than as a significant detriment to the program.

Another factor which could have influenced the implementation of the program and, subsequently student achievement, was the preparation of the teachers for using the computer equipment for classroom instruction. Although many teachers expressed apprehension in the beginning and confessed to little or no experience with computers prior to this teaching assignment, all the teachers interviewed seemed confident and in charge of this aspect of the program. Two factors seemed to be responsible for this outcome. First, knowledge of computer programming was not required to successfully use the equipment in the classroom. A minimum of technical knowledge was needed. Second, the inservice
provided by the school district, the service provided by the Computer Curriculum Corporation consultant, and the motivation of the teachers to teach themselves and help each other seemed to provide adequate teacher training for the program.

Recognizing the expectation that the socioeconomic status of students is related inversely to student achievement, this study used the percentage of students participating in the free and reduced price lunch program as a measure of economic deprivation. These patterns over a four year period were compared to achievement patterns for the same period of time, and the patterns are graphically displayed in Figures 3, 4, and 5 found in Chapter IV. Over the four year period economic deprivation generally tended upward in five schools and downward in one school.

However, achievement in both the ninth grade and the seventh grade generally tended upward during this same time period. Figures 3 and 4 reveal apparent peaks in achievement during the 1983-84 school year. This is probably the result of the testing date for this school year which was more than two months later than in the other three years illustrated on the graphs. Discounting this testing year, achievement trends were upward, and this is contradictory to expectation when deprivation is tending upward. One possible explanation is that the Academic Skills classes provided an intervention program which influenced mean
achievement scores in a positive direction. With the exception of one or two teachers, most teachers and principals believed that the Academic Skills classes helped to improve student achievement because it provided small group instruction, individualized drill and practice, and an approach which was different from others experienced by slow students in that it never reprimanded or discouraged them because of incorrect responses. Although the information was not available to the researcher, many teachers reported that pre and posttesting indicated that students made commendable gains in achievement. In addition to this, attitudes were generally positive, and parents were supportive of the program.

During a five year period from the 1980-81 school year through the 1984-85 school year, inclusive, the north Texas district included a unit on computers in the eighth grade mathematics curriculum for all eighth grade students in the school district. Using Commodore Computer equipment which was purchased a few components a year for the first four years, the students learned very basic programming and had some experiences using software for the computer. The total cost to the district for computers, peripheral equipment, maintenance, and supplies was about $113,000. Considering the number of students who had access to the computers during the five year period, the cost per student was about
ten dollars. The objectives stated in the district's five year plan included increasing achievement in mathematics by incorporating the computer unit into the curriculum. Other objectives stated by the teachers and the curriculum coordinator tended, however, toward the introduction of computer technology to the students.

Student access to the computers was very limited considering three factors, the number of computers purchased for each school, the time span over which the computers were purchased, and the portion of the school year dedicated to the unit of instruction. Each school had from thirteen to seventeen computers to use for mathematics instruction by the fourth year of the program. The schools which had seventeen had actually combined computers purchased for mathematics with those purchased for English to supply a lab which both departments could use. The computer unit lasted from three to six weeks depending upon the emphasis individual teachers wanted to devote to the unit.

In the beginning years of the program teacher preparation for teaching with computers was very inadequate. Since the unit of instruction included teaching basic programming skills, many teachers who had not had programming in their college work felt frustrated, anxious, and even angry because of the addition of this unit to the curriculum. Although all teachers seemed to be in charge of the
situation by the end of the fifth year, there is no doubt that the lack of preparation together with their negative attitude limited the achievement that students might have otherwise have made. District coordinators seemed to make good use of this experience, however. In the third year of this program a teacher training center was established and two teaching assistants were hired to provide inservice training for all teachers in the district using computers for instruction. These inservice programs were available to both elementary and secondary teachers during after school sessions and in the summers.

The measure of socioeconomic status used in this school district was the percentage of students participating in the free and reduced price lunch program. Figure 12, found in Chapter IV, charts the participation of students in each school over the five year period. These graphs reveal that participation was relatively stable over the years with only two schools showing noticeable up and down variation. When comparing these patterns to achievement trends which can be seen in Figures 9 and 10, also found in Chapter IV, the most obvious comparison is that the schools lowest in deprivation are highest in achievement, and vice versa. These trends follow those to be expected when comparing these two factors, i.e., there appeared to be no intervention of some type of program to break this strong relationship. It can
be noted from viewing Figure 10 that achievement trends over the years were generally upward. It is difficult to see trends from the eighth grade testing (Figure 9) since testing for the first four years was done in the fall and for the last three years was done in the spring of the year.

Although no specific link can be made between the use of the computers and the measured achievement in the district, the tone of comments made by principals, teachers, and students regarding the benefits to students from the program was very positive. Even the teachers who expressed annoyance and anger from being forced to teach the unit admitted that the students "loved it." The novelty of working with computers together with the fascination for programming it and the possibility of playing occasional computer games were highly motivating factors for students. Most teachers and principals noted that the small amount of exposure to the computers was not enough for most students. Some students interviewed were already looking toward the high school curriculum as a possible means of satisfying their educational desires regarding instruction using computers.

In comparing the two school districts with regard to their instructional computing programs many more differences than similarities are found. Although both districts had a formal goal of increasing achievement in mathematics through
the use of computers, the approaches were entirely different. Where one used mini-computers and remote labs with terminals the other used microcomputers. One district made a commitment of funds to support a one-to-one correspondence between computer terminals and identified students for an entire year of study and the other with a very low budget, set up the program as a supplement to the eighth grade mathematics curriculum with minimum student access to computers. With its commercially prepared program of computer-assisted instruction requiring little technical knowledge from the teachers, the west Texas district experienced few problems with teacher training. On the other hand the program in the north Texas district was highly dependent upon the technical skill of the teachers because the teaching of computer programming was required. This caused a flurry of activity on the part of the teachers in this district to meet the challenge. Although they seemed to do this, the resentment of being forced to do so was evident.

Measured achievement in neither district seemed to strongly support the idea that working with computers was a significant intervention program to break the strong link between the socioeconomic status of the students and their achievement; although some of the achievement patterns in the west Texas district might suggest this. It is clear from the student interviews in the north Texas district that
the attitude of the students was very high with many students being eager for more opportunities to work with computers both as a means of computer-assisted instruction in the basal subjects and as a way of learning more about the operations of computers. The students in the west Texas district on the other hand, may have had too much of a good thing, and "burn-out" as their teachers called it was a problem. From the comments of all the people interviewed it seemed that parents in both districts were supportive of the programs as were the administrations and boards of education who planned the programs and appropriated the funds to support them.

**Impressions**

In the west Texas district the cost of the computer-assisted instruction program called Academic Skills was high with approximately a half of a million dollars being spent over a three year period to serve academically deficient students in one grade level at each of six junior high schools. However, that high cost did purchase a specific and concentrated program with clear objectives and a very adequate supply of instructional materials and equipment which was consistently implemented in every junior high school. The reason for the consistency and probably for some of the high cost is the fact that the district
purchased a prepared, copy-righted, and patented program from a company whose primary business was to design, sell, and help school districts implement computer-assisted instruction programs.

At the other extreme the north Texas district instituted a low cost program, spending slightly more than one hundred thousand dollars over a five year period to provide a computer unit ranging from three to six weeks for eighth grade students in each of eight junior high schools in the district. Although consistently purchasing the same type of computers and distributing them equally to the schools, the program implementation was somewhat fragmented by the various levels of emphasis placed on the program in the different schools. This, together with the facts that materials were teacher made and teacher training was "on your own" and imperative due to the technical aspects of the objectives, caused considerable negative reception by both teachers and principals in the early years.

The expectation, that cost figures would be easily obtained from the general ledgers of the district because of anticipated consistency in following the Bulletin 679 Financial Accounting Manual published by the Texas Education Agency, was not realized. Cost figures were obtained by a tedious process of searching through general ledgers, budget documents, purchase orders, and price sheets as well as
returning to district coordinators a number of times to confirm facts and settle discrepancies. Much the same was true in securing other numerical data from the districts such as the test scores and attendance information. After several years records were lost and/or stored in remote and inconvenient places.

In analyzing the achievement data it was expected that achievement patterns over the years would be congruent with the implementation patterns of the programs. In other words it was expected that measured achievement would peak during the 1984-85 school year for seventh graders and during the 1982-83 and 1983-84 school years for the ninth grade students in the west Texas district. Although achievement tended upward for both grade levels during years in which economic deprivation also tended upward, suggesting some intervention by curricular programming or some other influence, definite links between achievement and the Academic Skills classes cannot be claimed. Achievement patterns in the north Texas district closely paralleled the expected patterns of socioeconomic status of students. No suggestion of linking measured achievement to the computer unit and thus the expenditure of the funds for the computer equipment can be made in this district either.

As regards the higher cognitive and noncognitive advantages as ascertained through the interviews in each of the
two school districts, the benefits are clearly positive. In the west Texas district the academically disadvantaged students were provided with a totally individualized program of instruction which met the needs on a multiple of skill levels. Not only did they have the advantage of one-to-one interaction with a computer-assisted instruction program for twenty minutes a day but also they had the opportunity for instruction each day by a certified mathematics teacher in a small group setting. With most of the teachers volunteering to teach the Academic Skills classes, the students had the benefit of a caring teacher who was in tune with their academic and social needs. In addition to the unqualified support of the building principals and the central office staff, the parents in the community seemed to recognize the benefits received by their children. The one small problem that some students may have experienced was "burn out" with the program toward the end of the year. This seemed to be more prevalent with students who were enrolled in both the English and the mathematics phases of the Academic Skills program. Most of the teachers recognized this problem and worked out solutions to at least partially relieve it.

Similar statements can be made about the noncognitive benefits as received by the students in the north Texas district. Widespread acceptance in the community was obvious by the many positive comments from principals,
teachers, and students. This fact was further supported by
the board of education which continued to appropriate
increasingly higher levels of funding each year, not only
for the junior high but also for elementary and high school
programs using computers for instruction. Support was
evidenced through greater spending as well as increasing
numbers of staff personnel. Parents were interested in
reinforcing the school programs by purchasing home computers
for their children, and students showed a high degree of
expectation and anticipation with regard to using computers
at school.

This study supports the findings of many researchers
that achievement and socioeconomic status of students are
highly related. But is also points to possibilities that
this chain can be broken with the intervention of academic
programs which are supported not only with a high level of
funding but also with a high degree of support from parents,
principals, and teachers. Furthermore, these programs have
higher potential for success when the students want them and
are enthused and encouraged by their use.

Implications

Some specific points can be made from this study and
applied to the structuring of future programs.

1. Programs should be planned in great detail well in
advance of implementation. Perhaps if this had been done in
the north Texas district some of the problems could have
been prevented. Including teachers and principals in the decision-making process might have insured their support in the implementation process. In the west Texas district the experiences of using the computer-assisted instructional program in the high schools during the 1970's seemed to help to provide for a smoother operation of the program when it was moved into the junior high schools in 1982.

2. Programs should be consistently administered and implemented throughout the school district if the expectation exists that a program will have an overall impact upon achievement of students in the school district. If a program is implemented districtwide at the direction of the administration and the board of education, degrees of emphasis at the school level should not vary from the district plan. Specific objectives and time allotments should be followed in every school. The west Texas district did this and came closer to showing program and thus expenditure impact upon achievement.

3. Teachers should be well trained prior to the implementation of the program. Both districts experienced some problems with this, but teachers in both district met the challenge. It is particularly imperative in programs which require technical knowledge such as the teaching of computer programming, that the teachers be well trained in advance of
implementing the program. Students cannot learn from teachers that which the teachers do not know.

4. Physical facilities should be planned and provided in advance of the implementation. Principals must be involved in this planning. Several principals in both school districts indicated that finding a room suitable for a computer lab was a problem. This was particularly true in schools which were already overcrowded with students when the computer classes were started. Involving principals in preplanning helps to ensure their support in the implementation phase of any program.

5. Programs should be selected that have wide acceptance from the community. This was the case in both school districts studied. Indications from the teachers, principals, and students interviewed were that most parents wanted their children to have experiences at school with computers both for computer-assisted instruction and for learning how to use computers for other purposes.

6. Programs should be selected in such a way as to provide for peak interest and enthusiasm on the part of students. This point was followed in both school districts. For students in the west Texas district, using computers for remediation in mathematics was a novel form of drill and practice, one which most of them had not used before. It provided them with positive experiences where they had only
experienced failure before because the programs were individualized to each student's skill level. Some variation in the routine might have relieved the "burnout" problem, however. In the north Texas district the students received just enough experience with the computers to make them look forward to more. This was an ideal situation for motivation of student learning.

Recommendations for Future Studies

There are some indications in the findings emerging from this study that links could be made between expenditures and measured student achievement if appropriate testing data were available. No study, however, should overlook other factors which promote a closer linkage, nor should measured achievement be the only factor used in judging the worth of instructional programs or in determining the levels of funding which will be appropriated for those programs. Other factors contributing to the value of instructional programs include the extent to which the programs motivate students and contribute not only to their learning but also to their feelings of self worth and their positive attitudes toward school. The key to the evaluation of these factors lies in qualitative research techniques.

On the other hand, limitations in evaluating the numerical data in this study could be avoided in future
studies if better accounting records were kept on costs of specific programs and if testing practices were standardized not only in each school district but across the state. Longitudinal studies are important in establishing relationships between program costs and measured student achievement, and a requirement for significant findings is consistent testing data. Most school districts have extensive and expensive testing programs. If care were taken in the planning of these programs, achievement information over a multiyear period would be valuable not only to independent researchers but also to district evaluators. Plans should include consistency in the time of the year tests are administered, and spring testing would be most useful in the evaluation of programs. Individual tests should be coded in some way regarding the socioeconomic status of pupils. It would also be very useful if test scores could be coded with information regarding specific school programs in which individual students participate. If this information had been available in the west Texas district, it is believed that strong positive links would have been indicated between expenditures and measured student achievement. This study made use only of school mean test scores. If mean test scores of students involved in the computer-assisted instructional program had been available, stronger results could have been expected.
Although complete expenditure data were available in both school districts, it was not readily accessible. It had been expected prior to the study that both school districts would have followed more closely the guidelines listed in the *Bulletin 679, Financial Accounting Manual* for the categorizing of expenditures. Had these guidelines been closely followed, securing expenditure information for any program at any specified grade level would have been less complicated. It is advisable for the sake of careful evaluation of future programs, that school districts in Texas follow these guidelines carefully. With costs ever increasing, and public opinion for the support of the public schools eroding, accountability for expenditures of funds will be demanded. School district must be ready to meet this challenge.

Meeting the challenge of regaining the public support of the public school system is going to require educating the public on the benefits which students receive beyond those capable of being measured by testing aimed at lower cognitive levels of achievement. Quality of educational experience cannot be evaluated solely with the analysis of achievement tests. Yet much of the "bad press" leveled at the public school system today is the result of the "brain-washing" people have experienced on the importance of achievement tests in the evaluation of the schools. Many
educational scholars and researchers believe that high level cognitive and noncognitive factors are more important indicators of student learning than are standardized achievement tests. But these factors are very elusive and difficult to quantify. It is the firm belief of this researcher that improved methods of qualitative research are a key to the public illumination of these important school benefits. More and better qualitative research combined with improved quantitative techniques is needed to publicize the effectiveness of schools.
APPENDIX A

SAMPLE INTERVIEW QUESTIONS FOR THE CURRICULUM COORDINATOR

1. What is the history of the use of computers in your school district?

2. When were computers first used in the junior high schools?

3. Was there a pilot program to begin with, or were they placed in all junior high schools in the same year?

4. What type of equipment is used in the district?

5. What type of software?

6. What is the selection process for equipment and software?

7. Are all of your software programs purchased, or are some teacher made?

8. What type of inservice training program do you have for the teachers?

9. Do you have a teacher training center?

10. How are teachers selected for teaching with computers?

11. How do you think the teachers feel about using computers in the classroom for instruction?

12. How do you feel about it?

13. How do you think the top administration and the board members feel about it?

14. How is the budget prepared for the computer program?

15. To what extent is it funded locally? By other funding sources?
16. Do you think the community would support a bond program for purchasing a large number of computers for classroom instruction?

17. What are the long and short range goals for the expansion of the use of computers for classroom instruction?

18. What do you see as the greatest benefits from using computers for classroom instruction?

19. What are the most difficult problems?

20. Do you own a computer for use at home? If so, for what do you use it?

21. How long have you had your present position?

22. What did you do before?

23. How long did you teach?

24. What is your educational background?
APPENDIX B

SAMPLE INTERVIEW QUESTIONS FOR THE SCHOOL PRINCIPAL

1. In what year did you first acquire computers for your school?
2. How has the program been expanded since that time?
3. What type of computers do you have in your school?
4. What type of software?
5. How are the students assigned to use the computers?
6. How many students have access to them?
7. How much time is available to each student for working with a computer?
8. Do all levels of students have access, i.e., special education through gifted?
9. How many teachers are involved in the program?
10. Describe the building inservice for the teachers working with the computers.
11. Is the use of the computers limited to mathematics?
12. Do you contribute to the budget planning as it relates to computers and software? Please describe the process.
13. What are your plans for the future for expanding the use of computers in your school?
14. How do you perceive the students attitude regarding the use of computers in your school?
15. How do you think the parents feel about it?
16. Does your PTA or other community organization support the program with donations or other means?
17. In what ways do you think your students most benefit from working with computers?

18. How long have you been principal at this school?

19. How long did you teach?

20. What did you teach?

21. Do you use a computer in your office here at the school or at home?

22. If so, for what uses?
APPENDIX C

SAMPLE INTERVIEW QUESTIONS FOR A MATHEMATICS TEACHER USING COMPUTERS FOR INSTRUCTION

1. How long have you had computers for classroom instruction?

2. How has your present program evolved?

3. Do you use computers for drill and practice, computer programming, or what?

4. What type of equipment do you have?

5. What software?

6. What is the grade level of your students?

7. Are they grouped according to ability?

8. Do some ability groups benefit more than others? In what ways?

9. How do your students respond to exposure to the computer equipment, i.e., what attitudes do they display?

10. How much training have you had for teaching with computers?

11. What is your attitude about using computers at this grade level for classroom instruction?

12. How do you think the other teachers in the building feel about it?

13. How do you think the parents feel about it?

14. How do you think the program should be expanded?

15. What type of equipment and software would you like to have?

16. Do you and the other teachers contribute to the budget preparation for this program?

17. How long have you been teaching?

18. What was your major in college?
19. What are your professional goals for the future?

20. Do you use a computer for any of your record keeping duties at school?

21. Do you use one at home?
APPENDIX D

SAMPLE INTERVIEW QUESTIONS
FOR A STUDENT

1. How long have you been working with computers at school?
2. How do you like it?
3. What are you learning?
4. How do you think it will help you in the future?
5. How much time do you get to use the computer at school?
6. What is your favorite thing to do with the computer?
7. How do you think the other students feel about having computers in school?
8. How do your parents feel about it?
9. Do you have a computer at home?
10. If so, for how long? For what do you use it?
11. How do you think the program could be improved?
APPENDIX E

SAMPLE INTERVIEW TRANSCRIPTIONS

A Principal

Interviewer: How long have you been at this school?

Principal: I've been here since '71. At that time, though, it was a high school. We just changed this to a junior high in August of '82.

Interviewer: Is that when you started using the computers for instruction in this building?

Principal: No, we had the computers even when we were a high school. We were the first to introduce it here to the high school students. And at that time we used them more or less for, I guess, kind of an exploratory thing. And computers, we didn't know much about it. We had an ISD person who was an instructional service person, and we wanted to try it. So we tried it in various areas of learning out there and used it mostly for skill work for the slow student. Now of course at that time, we had thirty-two machines, and the kids would do a certain amount of work within the building, and then the teachers could elect to carry them out, put them on the machines, and let them do the skill work. Of course that lasted, I guess we had those machines I would guess probably two years before we closed down as a high school. And then we opened up in '82 as a junior high school, seven, eight, and nine.

Interviewer: That would be the 1982-83 school year.

Principal: Right, 82-83 school year. Then we converted from the thirty-two computers to sixteen.

Interviewer: [The director of secondary education] told me that these computers out here are terminals, and that the main computer is located
somewhere. Is it--where is the main computer? Is it in this school or one of the other schools?

Principal: If I'm not mistaken, I think we have the main terminal here. I don't know a lot about that outfit. I don't deal with it that much, but the main setup is here for many of the schools, and I think there's another one. Because we're the first one that put one in. You'll go out, and you'll see the huge machine and everything because we've got other schools that when they're down, they call here, and I have to get one of my men or one of my persons that know how to go out and feed the machine and go back and get the information flowing again.

Interviewer: Who does that for you? One of the teachers?

Principal: One of the teachers. Now, when we were a high school, we had one particular person, professional person, and we had an aide that operated it. It took two people to run it, because we had thirty-two machines. When they changed to a junior high, they decided that there was no need for those. The professional person had a baby, so she took off (leave of absence). The aide, they decided, (the administration) that we no longer needed the aide, since we would have the sixteen machines out there. So they moved the eight to the elementary school. That left me to train a person to run the machine, which we did. Every year we almost had to put some new person out there, and then that person is having to be responsible when the machine is down for the other schools, to go out and make the correction. And many times the other schools are down for maybe an hour or two before we can get it up, compared to when the aide was there, the aide kept it up all the time. But many times with this person's planning period, or this person's teaching class somewhere else, there's no one out there. So those people, they're just lost for a while.
A Teacher

Interviewer: You think they would benefit from that?

Teacher: Yes, I really do. You know, we have some that finish so early on their assignments, that would be something that they could do, and then the ones that are having problems with just their computational skills. That would be something that would interest them to practice on it, instead of just sitting there with pencil and paper. They get real bored with that.

Interviewer: You said you have four regular eighth grade and one seventh grade honors. Your eighth grade classes then, are grouped. I mean, you have the regulars. Somebody else has basics.

Teacher: And another teacher has the honors.

Interviewer: How do your regular classes compare to say, your honors seventh grade class as far as what they can do on the computer.

Teacher: My seventh grade could do much more. The honors could do much more. What took me three weeks to teach to my regulars, some of my honors finished it in a week, or a week and half. And all of them were finished within two weeks. So we spent the last week, we went over some in-depth looping, and they each had to write -- they actually had to write a program that would work. They had four days to write it and de-bug it before they turned it in.

Interviewer: If you, in looking at benefits, do you think there's one group that would benefit more from having computers to use, not necessarily speaking just from the point of view of programming, but also using it for drill and practice or computer-assisted instruction.

Teacher: I really don't think anyone would benefit any more. I really think they would all benefit in some ways from it.

Interviewer: The lower ones would benefit from the reinforcement and--
Teacher: Right. And the honors just, they love it. All the kids love it. Even the basics. It's just something they get really excited about.

Interviewer: They look forward to it.

Teacher: Yes. That three weeks that we're in there, they're never tardy for class or anything. They're ready to go and they're real excited.

Interviewer: It's nice to have them excited about something.

Teacher: It really is. And that's one thing they would really get excited about is those computers.

Interviewer: Tell me about your own teacher training as far as using them. You said in the beginning, you had three hours. I take it to mean three real hours, not three college credit hours.

Teacher: Like one of the inservice days--those two days count. I did take a computer class when I was in college. That was part of my math credits.
A Student

Interviewer: What have you learned since then? You say you've learned some things on your own.

Student: Since then I've been in Mrs. Jones' homeroom instead of Mrs. Smith's. Kind of like a tutoring math. She puts me in there all the time. So I stay in there every day now. And whenever there's nobody in there for help, what I do is go sit down at the computer and Mrs. Jones sometimes has a few commands to let me know of. I'll learn those, and then I'll try to use them. And once I learn how to use them, I'll try to work it in any way I can. I've written a few security programs, and I've locked out a few of the teachers with it. Other than that I really haven't done all that much.

Interviewer: What does that mean?

Student: The security program's alright. It's just real small, a really small level. Anybody who knows a pretty good deal about computers will be able to figure it out and break into it. But all I'm really wanting the security programs to do is keep other kids out that are just going to try to mess it up or something.

Interviewer: Doodle around with it?

Student: Yes.

Interviewer: I can tell just from what you're saying to me that you do like it.

Student: Oh, I enjoy it all the time. I try to get as much in on it as I can. And now that the computers have been sorted out into the math classes, sometimes if we get through with our work, we can just go back there and work on the computers. And me and a few other kids in my class, we really, we don't really goof around, and we don't play games on them. We work them. So whenever I get back there, I just sit back there for the rest of the period and work on them.

Interviewer: What math class are you in?
Student: Mrs. Brown's second period.

Interviewer: Is it eighth grade math?

Student: Eighth grade.

Interviewer: It's the regular eight grade math?

Student: It's the regulars.

Interviewer: OK - Well, what do think you're going to do? Do you think you'll use this in the future in some way? Are you going to take more in high school?

Student: Right now, I've looked over the high school schedule and they have nothing except introduction to basic computer programming. My counselor tells me that by the time I'm a junior or maybe even a sophomore, they will have a lot more. Maybe five or ten, and I'm going to take all the computer classes I can.

Interviewer: Do you have some idea what you might do when you graduate from high school?

Student: Well - I'm not real sure. I'm hoping to get into something where I can work with computers more often and stuff. But I've always kind of wanted to work with building, work with my hands. You know like on cars or maybe plumbing or electrical work and stuff like that. I've always liked to work with my hands.

Interviewer: How much time would you say that you get to use the computer at school? Do you get to use it pretty much every day or--

Student: I get to use it a pretty good amount. A normal student would hardly get to use it at all really. That's as much as I know about that. I get to go into the math lab, and there's one computer in the math lab. And I get to use it whenever. Mrs. Jones just says, "Have at it" and I go. But I don't know about other classes.
## APPENDIX F

### Coding Categories

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP</td>
<td>Expenditures</td>
</tr>
<tr>
<td>ACH</td>
<td>Achievement</td>
</tr>
<tr>
<td>SES</td>
<td>Socioeconomic Status of Students</td>
</tr>
<tr>
<td>#C</td>
<td>Number of Computers</td>
</tr>
<tr>
<td>#S</td>
<td>Number of Students Using Computers</td>
</tr>
<tr>
<td>T/A</td>
<td>Time/Access to Computers</td>
</tr>
<tr>
<td>TYP/C</td>
<td>Type of Computer</td>
</tr>
<tr>
<td>TYP/S</td>
<td>Type of Software</td>
</tr>
<tr>
<td>OBJ</td>
<td>Objective of Computer Instruction</td>
</tr>
<tr>
<td>TP</td>
<td>Teacher Preparation</td>
</tr>
<tr>
<td>USE</td>
<td>Use of Computers</td>
</tr>
<tr>
<td>TA</td>
<td>Teacher Attitude</td>
</tr>
<tr>
<td>PA</td>
<td>Parent Attitude</td>
</tr>
<tr>
<td>SA</td>
<td>Student Attitude</td>
</tr>
<tr>
<td>PRIN/A</td>
<td>Principal Attitude</td>
</tr>
<tr>
<td>COORD/A</td>
<td>Coordinator Attitude</td>
</tr>
<tr>
<td>PROB</td>
<td>Problem</td>
</tr>
<tr>
<td>CONT</td>
<td>Content of Computer Instruction</td>
</tr>
<tr>
<td>DESEG</td>
<td>Desegregation</td>
</tr>
<tr>
<td>MOTIV</td>
<td>Motivation of Students</td>
</tr>
<tr>
<td>BENEFIT</td>
<td>Benefits of Use of Computers</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>NEED</td>
<td>Need for Improvement</td>
</tr>
<tr>
<td>SCHED</td>
<td>Scheduling of Students into Computer Lab</td>
</tr>
<tr>
<td>ABILITY GP</td>
<td>Ability Grouping of Students</td>
</tr>
<tr>
<td>FUND SOURCE</td>
<td>Source of Funding for Expenditures</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY

Books


Bogdan, Robert C. and Sari Knopp Biklen, Qualitative Research for Education An Introduction to Theory and Methods, Boston, Massachusetts, Allyn and Bacon, 1982.


Kiesling, Herbert J., Input and Output in California Compensatory Educational Projects, Santa Monica, California, Rand Corporation, 1971, (ED059174).


Miles, Mathew B. and A. Michael Huberman, Qualitative Data Analysis A Sourcebook of New Methods, Beverly Hills, California, Sage Publications, 1984.

Patton, Michael Quinn, Qualitative Evaluation Methods, Beverly Hills, California, Sage Publications, 1980.


Articles


Bryant, Deborah, "Computer Selection for Schools... The Road to Success," Texas School Business, XXX (September, 1984), 4.


Herch, Richard H., "How to Avoid Becoming a Nation of Technopeasants," Phi Delta Kappan, 64 (May, 1983), 635-638.


Lawrason, Robin, "Are Computers the Problem or the Solution?" Instructional Innovator, 28 (May, 1983), 34-5.


Reports


Coleman, James S., The Evaluation of Educational Opportunity, Baltimore, Maryland, Johns Hopkins University, August, 1968 (ED 026721).


Public Documents

Unpublished Materials


Newspapers