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Microcomputer utilization in elementary schools: A Henderson County case study

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The University of North Carolina at Greensboro, 1987

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MICROCOMPUTER UTILIZATION IN ELEMENTARY SCHOOLS: A HENDERSON COUNTY CASE STUDY

by

Frederick Eugene Taylor

A Dissertation submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
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Approved by

Dissertation Advisor

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at the University of North Carolina at Greensboro.

Dissertation Advisor ____________________

Committee Members ____________________

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TAYLOR, FREDERICK EUGENE. Microcomputer Utilization in Elementary Schools: A Henderson County Case Study. (1986) Directed by Dr. Dale Brubaker and Dr. Kieth Wright. Pp. 126.

The purpose of this study was to report the results of a survey on computer programs conducted among the certified personnel in Henderson County elementary schools. Respondents registered the intensity of their attitudes to two groups of stimuli: factors which limit the current program, and factors which might be added or changed to improve the program in the future. The survey also gathered information about the teachers' certification levels, experience, and computer training.

The results of the survey indicated that respondents to the survey are comparable to the entire staff in certification and experience, that they are comparable to statewide norms in the area of experience, and that they are slightly above state averages in terms of graduate degrees.

Survey responses indicated that teachers' chief concern is for planning time. Other strong concerns are for a specifically trained staff member to assist in the computer area, for an expanded computer inventory, and for a greater supply of software.

The survey of literature carried out in connection with the total research project indicated that current reputable writers, the majority of whom are not

elementary educators, are concerned that computers are too often used for drill and practice activities and that schools are not developing the potential to train pupils in higher order thinking skills.

The conclusion of the study is that the literature records the long range vision of what computer programs might be; the opinion survey reflects a more pragmatic perspective. As computer programs evolve beyond the formative stage, the more mature design will reflect the influence of both the visionary leaders who publish and the building level educators who interact with both pupils and computers.

ACKNOWLEDGEMENTS

I would like to express appreciation to the members of my Dissertation Committee, Dr. Dale Brubaker, Dr. Kieth Wright, Dr. Harold Snyder, and Dr. James Runkel. I extend special thanks to Dr. Brubaker and Dr. Wright who co-chaired the committee.

I esteem Superintendent Glen Marlow and the other educators with whom I work in Henderson County. The caliber of their performance has stimulated my own professional growth. I acknowledge my indebtedness especially to the elementary personnel for their cooperation in providing research data.

I reserve my warmest regard for my wife, Katharine. An educator herself, she has provided both personal and professional support.

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CHAPTER I

INTRODUCTION

Background of the Problem

This dissertation will report the results of an opinion survey on computer programs in the elementary schools of Henderson County, North Carolina. In addition it will summarize current published attitudes and opinions by synthesizing more than two hundred journal articles published within the past two years. The investigator will compare the material from teachers and published sources, identifying both agreement and disagreement. The dissertation will offer biographical information about authors as an aid to the reader in evaluating the published material. It will offer information about teacher certification, experience, and computer training to guide in evaluating survey data. To further assist the reader, information will be included to characterize the Henderson County schools since teacher opinions will reflect the system in which they originated. This research will focus on computer use in elementary schools and will address issues of interest to educators who are using computers as tools for computer-assisted instruction at that level.

Public schools are well past the point of getting ready for the computer age. They are squarely into it--with less than adequate preparation. The National Task Force on

Educational Technology describes the advent of computer technology into the schools with these succinct sentences:

> Too often, decisions for purchase and use were made without well-conceived plans to integrate the technology into the overall educational plan. Frequently, the technology was either thrust upon the schools by well-meaning enthusiasts or purchased defensively to ward off real or imagined community pressures. Many individual teachers were supplied with microcomputers without first being convinced about their usefulness or receiving even rudimentary training in their proper application. As a result, the technology was not used as it was originally designed to be (Transforming Education, p. 59).

High schools had computers before elementary schools had them, and secondary math-science specialists typically were the first computer specialists. Many of these early computer teachers were self-taught secondary educators who became computer teachers, computer coordinators, and instructors for inservice courses. In 1984 when the state legislature first made a specific appropriation for elementary computer programs in North Carolina, the elementary schools were probably as unprepared as indicated in the National Task Force's assessment. Available leadership usually came from educators whose orientation was toward secondary rather than elementary education. Furthermore, few published articles were addressed to elementary schools.

In areas such as banking, charge accounts, and utilities, society has felt the effects of the computer age

for a number of years; but not until the early 1980's did the impact of computer technology begin to touch elementary schools forcefully. Prior to the 1984-85 school year most computers in elementary schools had been placed there for use by academically gifted pupils. With specific funds available in 1984-85, schools began to add computers for general use at the elementary level; and by the end of that term there were approximately 7,000 microcomputers in 1,400 elementary schools in North Carolina.

In July of 1984 when the Educational Media and Technology Services, North Carolina Department of Public Instruction, informed superintendents that computer funding had been authorized by the legislature, they also notified them that a computer plan would be required before funds would be released. The memo directed school systems to develop goals and identify student competencies which would indicate progress toward the goals. The memo included suggested goals for elementary grades:

The student can:

- describe the computer as a problem-solving machine
- recognize and be familiar with computer words and computer parts--their meaning and uses
- recognize several early computing devices and compare each to modern computers
- identify the capability and limitations of computers and daily uses of computers

- load and run programs
- use introductory commands of a computer language to create and control computer shapes or a program output

These simple goals set the stage for general computer use in the state. Four of the six goals would not actually require the use of a computer for their accomplishment, and the other two required only the most rudimentary skill. Some units adopted the suggested goals without change; others modified them slightly. Henderson County's computer plan, submitted to qualify for funding, modified the wording of the state-suggested goals but did not make substantive changes.

Data for this research will reflect opinions formed over a two year period, from the fall of 1984 when funding began to the end of the 1985-86 school year. The most significant aspect of the survey, however, is that data will be gathered from educators who have observed the interaction of pupils with equipment and software. Not only have they observed the interaction, they have participated by selecting materials and planning experiences aimed at achieving curriculum goals. Their survey responses will record the on-the-scene, professional opinions of educators seeking to achieve educational objectives through the use of a new media.

Statement of the Problem

The researcher faces several challenges in developing this research project. One challenge is to discuss a potentially technical topic in a meaningful but understandable way. Another challenge is to make a balanced presentation of both published material and survey information. This challenge is intensified by the need to compare the visionary views found in published sources to the practitioners' narrower but practical perspectives. Another challenge is to draw attention to computer matters in relation to curriculum.

For the immediate future it is quite acceptable that computer programs claim a disproportionate share of attention, energy, and effort from the certified personnel in elementary schools. Competencies gained through extra experimentation, reading, and conferencing will benefit both current and future pupils. Taking a long range view, however, computers are simply one of many educational tools. As educators adjust to their presence, perspectives should change. Anxious self-consciousness will give way to informed self-confidence, and computers will blend into the educational environment as just one more tool available to promote curriculum goals. A sixteen-year-old behind a steering wheel invests total concentration in the operation of the vehicle; experience soon enables him to be far more casual about the driving process and permits consideration

of the destination. As educators gain confidence through experience, they will think less about the process and more about destination.

Statement of Personal Experiences

To assist the reader in assessing the attitudes and biases of the writer, I shall relate some of my professional background and experiences which led to a computer interest sufficient to undertake this particular paper. I have been an elementary school principal for fifteen years and my prior experience was junior and senior high school English teaching.

My very first exposure to computers was in an administrators' meeting where a supervisor demonstrated a program intended to illustrate the potential of computers as aids to instruction. The short demonstration included items from several areas of learning and at several instructional levels. My reaction was that the highly touted tool violated many of the learning theories that I felt were important to effective teaching, so I left the meeting with a very negative feeling toward technology which the supervisor declared I would surely face in the near future. Thereafter I had several similar experiences over a period of two or three years, and I hoped that computers would not find their way into my building until after I retired! My hopes proved groundless, however, and in the fall of 1983 a computer was delivered to the school with the promise that

more would follow during the first semester. Not only that, the PTA expressed strong interest in using proceeds from its annual fund-raiser to add even more computers. With a bite-the-bullet attitude, I enrolled that fall in my unit's computer orientation course which began on a hot fall afternoon in a junior high computer lab after the air conditioner had been turned off for the day. The first sessions included several films, numerous definitions, and chalkboards full of diagrams. I remained less than enthusiastic.

Eventually we began to use the equipment. The instructor demonstrated a few simple programming techniques and offered us an opportunity to experiment with some commercial programs. He also invited those of us from elementary schools to bring programs from our own media centers to examine during our lab time. During these sessions I began to recognize the computer as a powerful teaching tool that could be managed within sound pedagogical limits, and my negative attitude changed to positive enthusiasm. Since that initial exposure I have taken every computer course I could work into my schedule, have purchased a computer of my own which I use almost daily, and have spent many hours writing simple programs for the pupils in the elementary school where I am principal.

I am concerned that too few elementary educators are preparing to participate in decision making in the computer

area. With good reason, system level administrators initiated computer programs in high schools; after all, they had the pupils who would immediately enter the high-tech job market. Most high school computer programs focus on teaching about computers; most elementary schools teach with computers. Therein lies a problem that must be addressed. Educators who are oriented toward high school programs concentrate largely on the technical aspects of computers--learning computer languages, planning and writing programs, and understanding theories of mathematics and logic by which people manage and control the machines. Many educators who are oriented to elementary pupils view computers as additional audio visual equipment, machines which, like the record player or filmstrip projector, are tools to be used in teaching the elementary curriculum. Elementary educators as a group do not have time to become computer specialists. Some, however, do need to become sufficiently prepared to participate intelligently in important decision making which affects the way computers will be used at the elementary level. Administrators who work with elementary pupils and teachers would be excellent candidates to fill this liaison role between elementary educators and technologists.

Basic Assumptions

This study assumes the following premises:

1. The articles cited in this paper are, because of their selection for publication, accepted as creditable viewpoints.

2. The educators who responded to the survey are, because of their credentials and experience, accepted as creditable spokespersons for their viewpoints.

3. The published sources and the educators who provided data for this research are qualified to offer significant opinions.

The researcher used the standard research tools available in university libraries to locate books and articles for this research. Sources cited are creditable at least to the extent of inclusion in standard indices. The educators who participated in the survey have training and experience which compares favorably to teachers in other units over the state. Biographical data concerning writers and a more detailed description of the survey participants will be included in Chapter II, "Survey of the Literature." This elaboration is sufficient to support assumptions.

Definition of Terms

Researchers traditionally define terms. Often the purpose of such definitions is to establish precise definitions applicable to the particular project at hand. The impact of computers on society has been so great that some readers may lack clear understanding of common computer vocabulary. They may be unaware that many specialized

computer terms are now included as regular entries in current dictionaries. The source for the definitions, listed in alphabetical order, is Webster's Ninth New Collegiate Dictionary. Dates in parentheses indicate "the earliest recorded use in English, as far as it could be determined, of the sense" selected for this paper (Webster's Ninth, p. 17).

BASIC: (1967) a simplified language for programming and interacting with a computer (Beginner's All-purpose Symbolic Instruction Code)

computer: a programmable electronic device that can store, retrieve, and process data

disk: a round flat plate coated with a magnetic substance on which data for a computer is stored

diskette: (1973) floppy disk

drive: a device for reading and writing on magnetic media

floppy disk: (1973) a small flexible plastic disk coated with magnetic material on which data for a computer can be stored

memory: capacity for storing information as a computer with 16K of memory

microcomputer: (1971) a very small computer

microprocessor: a computer processor contained on an integrated-circuit chip

screen: a flat surface on which the image appears in an electronic display as in a computer terminal

software: (1962) the entire set of programs, procedures, and related documentation associated with a system, especially a computer system, specifically computer programs

terminal: a device by which data can enter or leave a communication network

word processing: (1973) the production of typewritten documents with automated and usually computerized typing and text-editing equipment

word processor: (1977) a keyboard operated terminal usually with a video display and a magnetic storage device for use in word processing; also software to perform word processing

Though the preceding list is lengthy, it is offered as an aid to the school administrator for reading this paper with understanding and to call attention that computer language is a part of the fibre of today's society as evidenced by the fact that these definitions came, not from computer literature, but from a standard dictionary.

Understanding of computer language is often assumed, and unfamiliar terms sometimes become parts of phrases. For instance, the term "computer" may be used imprecisely to refer to the computer as well as the screen on which information is displayed and the drive which retrieves or stores information on a disk. An example of a phrase is "double disk drive." This refers to two drives connected to the same computer, an arrangement which simplifies an operation such as word processing when it is convenient to have the capability to alternate between retrieving and storing information.

Reference was made in the list of definitions to programs stored on software. This paper has already mentioned "computer programs" several times, and succeeding pages will continue to use the term to mean all the

activities in which computer equipment is used in a school or school system. The term "computer program" or simply "program" might be used also to refer to specific information stored on a disk for use in a teaching situation. For instance, one might say that a student used a program which offered drill on addition facts. Context clues should be sufficient means for the reader to avoid misunderstanding in the two uses of the terms "computer program" and "program."

Methodology

Descriptive Design

The data collected for this research will be obtained through an opinion survey directed to the entire certified elementary staff in the Henderson County, North Carolina schools. Prior to any other activity, the researcher discussed his plan with the superintendent of schools and secured his permission to proceed. Educational Research (Gay, p. 153) contains a chapter entitled "The Descriptive Method" which enumerates a number of principles necessary for sound descriptive research. When one is gathering information for a unique study, an instrument must be designed. In its final form it should be neat and attractive and designed, if possible, to avoid open-ended questions. It should, however, contain an "other" category to permit respondents to frame individual answers if desired. It is recommended, too, that the instrument be

delivered with the endorsement of an authority figure whenever possible and that arrangements be made for replies to be returned with minimum inconvenience to the respondent. Questions for which they do not have answers should not be asked of the target population, and the information sought should not be trivial. The instrument should include written directions to assure that each respondent is following uniform instructions. Touchy issues and leading questions should be avoided, and anonymity should be carefully arranged to promote candor. A pilot test of the survey instrument helps the researcher to avoid costly and time-consuming flaws. The investigator was fortunate to have had these precepts pointed out while this project was in its formative stage; in addition, Professors Dale Brubaker and Edwin Bell of the University of North Carolina, Greensboro School of Education offered their personal guidance during the planning. The following paragraphs will illustrate that this research carefully follows the recommended procedures for descriptive research.

The final survey instrument will be designed to poll certified staff members to learn two things: (1) characteristics of elementary computer programs the respondents perceive as limitations; and (2) things they would deem helpful. The purpose for this particular focus is to seek a broad range of answers and to offer opportunity to respond to one question that is negative in its

connotation and one that is positive. The writer drew upon his experience as a principal, as a workshop participant and presenter, as a software user, and as a neophyte programmer to design the first draft of the survey. The initial version contained a list of fourteen choices for limitations and sixteen choices for things that would be helpful.

In addition to soliciting opinions, the instrument will ask respondents to indicate the grade level at which they work, their years of experience, whether they have an "A" or "G" certificate, and specific computer training they have had. The writer administered a pilot test of the survey to approximately ten percent of the target population in two of the ten target schools. One school in the pilot test has its computers in a computer lab setting; the other has them in classrooms. This choice of pilot sites was deliberate; it was assumed that differences in setting would evoke different responses and thus expand the list of possible survey terms. Participants in the pilot study were encouraged to use the "other" option freely and were carefully instructed that their role in amending the document was more important than their actual answers to the questions.

The result of the pilot test was the addition of eleven items to the list of limitations and eight to the list of helpful things. Analysis of the pilot test responses showed that every option on the original survey except two had been

used at least once in the pilot. The additional items were added to the original form, and the revised instrument will be used to conduct a survey throughout the County. Both the initial and final versions of the survey form appear at the end of this report as Appendices A and C.

After the survey instrument is in its final form, copies will be personally delivered to each of the ten elementary principals at a regularly scheduled luncheon meeting of the local principals' association. As a gesture of appreciation for their cooperation, the investigator will treat them to lunch and suggest that they ask their secretaries to record returns on a staff check list over the following two weeks and offer personal reminders as convenient to non-responders. Use of this method of giving reminders will not interfere with anonymity; secretaries will keep notes on who responds but will not match responses to respondents.

Each survey form will carry a cover letter which acknowledges the value of the time they will spend in responding, thanks them in advance for their helpfulness, and indicates that their professional expertise will be meaningful. A copy of the cover letter is appended as Appendix B. Internal evidence from Appendices A, B, and C together with the preceding description of methodology validate sound research procedures.

Significance of Study

This study is important because it will report attitudes and opinions about elementary schools' use of computers from those most qualified to speak: elementary teachers who have been using computers with students for over two years. It is they who make the dozens of decisions every day which create the opportunities for learning. It is they who set the learning pace and select the materials. They know the content of their curriculum guides and teacher manuals, and they are keenly aware of the knowledge and skills pupils will need to meet the challenges of the grade to which they will advance next year. They are supremely aware of their responsibility to groups of pupils as well as to individuals. Their attitudes and opinions reflect their opinion of the best way to achieve the greatest good for the greatest number. Teachers, of necessity, are pragmatists; and this research will report that view.

Many who publish articles and books are visionary. This research will report their views also. Those who have produced the books and articles which propose what might be attainable in the computer area have schedules which, unlike those of teachers, permit reflection, exploration, and inquiry. Ideas gathered from current publications in the field will be examined and considered. Only because forward looking leaders envisioned longer terms and higher grade levels do we have twelve years of nine months instead of

short mid-winter sessions. Visions preceded realization of vocational education, lunch programs, special services, and hosts of other educational advances. "Man's reach should exceed his grasp," (Tennyson, "Andrea del Sarto") in the computer field as it has in these other areas.

Teachers could not possibly use or even know about all the technological and innovative aids available on today's market. However, "teachers in their classrooms can make or break the most appealing of them. Things happen or don't happen when the classroom door closes." (Goldberg, p. 24) The educators who participated in this research invite the outside world to look behind those closed classroom doors at what they think important in teaching children. The literature cited invites consideration of improvements. An elementary school focus and a deliberately non-technical presentation offer administrators an uncommon opportunity to ponder curriculum and computers simultaneously and consider both what is and what might be.

Limitations of Study

This study admits the following limitations:

1. Published material about elementary computer programs is limited, and much of what is available occurs incidentally in general articles about school computer programs.

2. The advent of computer programs in elementary schools is historically a very recent event; generalizations based on such a short time span should be accepted conditionally.

3. The computer movement in public schools has been so recent, so sudden, and so intense that no popularly accepted authorities have emerged; a researcher finds it necessary to accept all authors as people of approximately equal stature.

4. Meaningful books are very scarce; periodical literature is distinctly more up-to-date than books, and articles old enough to appear in indices are often outdated by articles in current, yet-to-be-indexed periodicals.

5. School systems vary greatly in computer equipment, application, and staff training. The survey results would probably differ if one or more of these variables changed significantly.

Three of the above limitations allude to the time frame of the computer movement. An illustration might underscore the uniqueness of this research project in regard to time: Suppose three researchers were investigating John Milton's poetry, legal aspects of corporal punishment, and computers. The Milton study would cover a period beginning in about 1600, and the legal study might begin about 1800. The computer paper might begin with the introduction of the microchip at about 1960. If one assumes that the investigation and reporting required two years for each of the hypothetical projects, the computer research project would occupy nearly eight percent of the elapsed time from the event to the present. (From 1960 to 1986 is 26 years. Assuming two years of research time, 2 years divided by 26 years equals slightly less than .08. A two year research effort, therefore, occupies approximately 8 percent of the historical span of computers.) Calculated the same way, the legal research would occupy about one percent and the

Milton research less than one-half of one percent of the topic's history. The Milton research could be conducted by examining data in a stable field, and the merit of the results could be measured against other recognized authorities. The computer research could not be conducted or presented in a similar context. The information base is not stable, and there are no recognized authorities by which to judge computer research. Computer research is, of necessity, conducted and reported in a context different from many other fields.

Presentation Plan

The next chapter of this paper will summarize ideas and concepts from approximately 400 articles on computer programs. About half were written more than two years ago and will be used for general information and background. These older articles have been collected and published as anthologies and are referenced as books rather than as individual journal articles. The remainder are more current and appear individually in the bibliography. Greater emphasis will be placed on the more recent material. A number of books will also provide both computer and curriculum information as the intent of this project is to focus administrative attention on computers as tools for instruction.

Chapter three, "Analysis of Findings," will report the results of the teacher survey. This chapter will also

include background data about the school system from which the surveys were drawn and about the teaching staff--their experience, their credentials, and their certification. The final chapter will present summary, conclusions, and recommendations for further study.

CHAPTER II

SURVEY OF THE LITERATURE

Since a goal of this dissertation is to report on computer programs in elementary schools and to relate the discussion to curriculum, a rather broad survey of literature is indicated. Literature on two topics, curriculum and administrative leadership, will be discussed to create a backdrop against which to examine writings that are specifically about computers. This chapter will review representative literature related to computers as instructional tools. The focus will be on learning theory and curricular applications rather than on technology.

Curriculum Considerations

Rubin states that "curriculum can be defined in various ways. Generally, however, it is assumed to encompass the total impact of the school environment on the learner" (Rubin, p. vii). "Curriculum" as a course of study is part of Rubin's definition but certainly more than this alone. He continues his introduction to an anthology of curriculum related essays by naming more than a dozen nationally known scholars and identifying each with a specialized interest in the broad area. Computers certainly have had an impact on the environment of the learner. Media specialists, administrators, aides, and most especially teachers and

pupils now function in computer-equipped environments. Many currently enrolled elementary school pupils have experienced school both with and without computers. The arrival of this equipment re-ordered schedules and the allocation of financial and labor resources, to name but a few of the influences upon school environment. However, Rubin's definition encompasses a far broader concept than can be treated in a discussion of schools' computer programs. A more practical definition for curriculum as related to computer programs would be those things which are listed as learning goals and outcomes in curriculum guides and manuals which accompany texts and other classroom materials. North Carolina educators are guided in the selection of materials by the state's Basic Education Plan.

Adler's Concept

With a working definition of curriculum in mind, it is next necessary to consider whether learning goals and outcomes should apply to all pupils. Adler advocates "the same objectives for all without exception" (Adler, p. 15). The same writing "rejects with abhorrence the notion that there are any irremediable deficiencies to block the attainment of the same educational goals for all" (Adler, p. 45). These quotes from The Paideia Proposal, represent the thinking of educational leaders known as the Paideia group. As stated earlier, educational systems are indebted to leaders of vision for many advances; and the Paideia group

may be pointing to an ideal toward which educators should strive. Computers are with us now, however, and must be utilized in schools which deal with academic deficiencies. Whether these deficiencies are remediable or not, they are found in the same classrooms where the computers are located. For the foreseeable future computer programs should be adapted to meet the needs of pupils who have varying capabilities and learning styles.

Macdonald's Concept

Another writer who espouses a non-traditional school structure is James B. Macdonald in Reschooling Society: A Conceptual Model. Harold G. Shane, President of the Association for Supervision and Curriculum Development, anticipated divided opinion when, discussing background philosophies, he wrote in the Foreword "that each ideological camp sometimes presented the worst features of their opponents' ideas as typical of their proposals for educational change.

Forewarned, this researcher will seek balanced, not extreme, ideas from Macdonald's work as an additional element in the backdrop of curriculum considerations by which administrators might make decisions about computer programs. Macdonald finds current trends toward efficiency and the use of "objectives predetermined by curriculum experts, written guides, and/or teachers" oppressive (Macdonald, p. 1). He feels that students should be taught

holistically, that education should be personalized as opposed to standardized, and participatory rather than dominated by authority. Some educators, particularly administrators whose normal milieu is the authoritarian mode, might have legitimate concerns about Macdonald's proposals. Since computer programs lend themselves to individualization, then holistic, personalized, participatory activities are possible at least in that area if not throughout the school.

Schubert's Concept

In another curriculum publication, an anthology of essays, Schubert discusses grouping practices. He makes a basic assumption that pupils do differ so markedly that a perennial question among educators is whether to group heterogeneously or homogeneously. After discussing the advantages and limitations of each method, Schubert concludes that educators spend time looking for solutions to general problems and that specific situations, being unique, require creative approaches. This writer recognizes that significant differences among students are present in classrooms and require our attention.

Though Schubert was writing about grouping to accommodate differences, it seems reasonable to extrapolate his theory to apply to differences among individual pupils who might be using computers. This researcher will accept the premise that differences do exist among members of

classroom groups and that educators should plan computer programs, as they plan other activities, with differences in mind.

Brubaker's Concept

Brubaker feels that educators should think creatively about curriculum matters. Since computer programs are a new element in the school environment, the following seems especially apropos:

> We need to give more attention to alternative views (perceptions) of time and space. The practitioner easily becomes locked into behavior patterns based on certain assumptions concerning the use of time and space. Those who work and plan in elementary schools have been members of educational organizations throughout their lives and these organizations have consistently reinforced certain assumptions and behaviors relative to the perception and use of time and space. All of us are, therefore, challenged to become conscious of our own views of time and space as we relate to elementary school children. We are also challenged to consider different views of time and space, some of which are practiced in other settings within our culture and other cultures (Brubaker, p. 179).

Morsund makes Brubaker's challenge more specific by questioning several traditional practices. He points out that digital watches have become so common that schools might need to re-structure their teaching about telling time. He points out that the calculator is so ubiquitous and so efficient at computation that we seldom use traditional paper-and-pencil methods for operations such as multiplication of large numbers, division of decimal fractions, and extracting square roots. He suggests that

mathematics teachers might better stress concepts such as looking for reasonable answers or developing the ability to estimate. Since word processing capabilities are now so commonplace, he questions whether penmanship should retain its traditional importance in our curriculum. Finally, he asks, "If a computer can check one's spelling, does spelling remain at its current level of importance?" (Moursund, p. 23).

This investigator agrees with Brubaker that "the practitioner easily becomes locked into behavior patterns," and Moursund certainly raises valid points when he questions whether some time-honored practices should continue. Traditional penmanship and spelling lessons will probably yield only slowly to word processors and spelling checkers. Not only will it be necessary to make software and equipment generally available; educational theory and practice will require adjustment as well. The advent of computers into schoolrooms represents much more than a new teaching tool. Computers have made a pervasive cultural impact and will require highly creative use of time and space for effective assimilation into the curriculum.

Bloom's Concept

Bloom's benchmark educational writing, Taxonomy of Educational Objectives, Book 1, Cognitive Domain, deserves comment in creating the backdrop against which to examine computer programs. Originally published in 1956, the

classification system contained in this publication has gained immense popularity. Educators frequently refer to "Bloom's Taxonomy," and it provides a convenient framework within which to consider computer learning. The book designates six levels of difficulty for learning. From easiest to most difficult they are labelled knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, Taxonomy, p. 18).

In 1948 a group of examiners began discussion at a meeting of the American Psychological Association Convention. These discussions led to the publication of the Taxonomy in 1956. The book names six major classifications, divides them into sub-skills, and provides example test questions by which to gauge mastery at each level. The illustrative questions are applicable to high school and college material, so only the taxonomy is applicable to elementary school.

This investigator, having encountered numerous bibliographic references to Bloom's Taxonomy in computer literature, communicated with Bloom to ask if he could recommend a source that would include elementary level examples of questions for each of the levels identified in the Taxonomy. Bloom recommended Handbook on Formative and Summative Evaluation of Student Learning as a source for this information.

The following information elucidates each of the six levels and provides a guide by which elementary personnel may relate computer programs to Bloom's Taxonomy. The investigator has chosen the simplest examples from the reference; and the material suggests that, in general, the higher the taxonomic level, the higher the grade level. Stated in a more straightforward manner, elementary material includes a higher proportion of knowledge level material.

Knowledge material requires supply type answers. "If 6 is multiplied by 8, the answer is _____" (Bloom, Handbook, p. 145). "The name of the third President of the United States is _____" (Bloom, Handbook, p. 145).

Comprehension material may require translation as of a French passage into English. Another type of comprehension material may require interpretation of graphs as when determinining the most dangerous hours for driving by examining a graph of fatal accidents by hour of occurrence. A slightly more difficult level of comprehension activity would be to look at a graph and make predictions (Bloom, Handbook, p. 149).

The application level includes activities such as "the ability to present ideas (orally or in writing) in accordance with the principles of grammar" (Bloom, Handbook, p. 160). Application activity occurs also when one "explains events in daily life in terms of scientific principles, concepts and theories" (Bloom, Handbook, p.

160). When a student chooses a correct verb form or uses a new vocabulary word in writing a paragraph, application of learning has occurred.

Skill at the analysis level is needed "to recognize the point of view or bias of a writer in an historical account, to distinguish cause and effect relationships from other sequential relationships, or to recognize unstated assumptions" (Bloom, Handbook, p. 179). Thinking at this level occurs even in kindergarten as when pupils look at pictures and draw conclusions about scenes and events.

Bloom identifies synthesis as the next step above analysis in the six-step hierarchy. Divergent thinking skills are necessary at the synthesis level; at the previous levels convergent thinking was primarily important.

> Up to the level of Synthesis--Knowledge, Comprehension, Application, and Analysis--can be regarded as convergent thinking, and the test illustrations for the majority of these behaviors can be of a form in which the correct or best answer can be determined in advance. Synthesis, however, appears to be a type of divergent thinking in that it is unlikely that the right solution to a problem can be set in advance (Bloom, Handbook, p. 194).

Such activities as creative writing, composing music, and constructing graphic materials require thinking at the synthesis level.

Evaluation is the sixth and highest order of thinking skills identified by Bloom. It is at this level the student forms judgments which may be quantitative or qualitative and

may be on bases such as good-bad, like-dislike, or desirable-undesirable (Bloom, Handbook, p. 204). Activities such as verifying the accuracy of computations, checking the validity of inferences, and recognizing gaps, contradictions, and redundance employ evaluation skills.

Curriculum Concepts Applied to Computer Programs

Much of the literature which will be discussed later in this dissertation makes specific suggestions about computer application in the educational setting. Computers do not appear in classrooms without affecting other things which take place there. Funds spent for computers could have been spent on other resources; professional time that is now directed to computers could be otherwise used; even the space the computers occupy could be used differently; and above all, pupil time, were it not used at computers, would be filled with something else. These things being true, it is important to have a curricular frame of reference when considering computer programs. For the purpose of this paper the following ideas are accepted:

- Learning activities have different levels of difficulty.
- Pupils have different levels of ability.
- The curriculum is considered to be the learning goals and objectives contained in curriculum guides and teacher manuals.

Principles of learning, curriculum theory, and administrative style apply to computer programs no less than to text selection or traditional lesson plans.

Administrative Leadership Considerations

The appropriate role for school administrators in establishing computer programs is suggested by the following:

> The future of computers in education need not be the product of the computer industry. It need not be the product of outside groups attempting to provide intensive service in their conceptualization of computer literacy. Rather, the future of computers in education can be the product of groups of teachers, administrators and educational technologists systematically planning for (and eventually creating) the future. The challenge is to stop asking, "What does the future hold for computers in education?," and start asking, "What type of future do we want to create for education involving computers?" (Wedman, p. 148).

Suhor urges educators to shape computer programs rather than allow computer technologists to impose them.

> I predict that the educational technology that dazzles us today will be put to numerous tests of research, and weighed against traditional technologies and methods--the spoken word, for example--which will prove more "user friendly" than a joy stick. I predict that language arts computer materials will be produced with the learner's language growth in mind--no-nonsense materials that use graphics organically, not as gimmicks. I predict that easy phrases like computer literacy, computer languages, and interactive software will be deflated by simple semantic analysis, by sheer overuse, and by the disillusionment of those who come to know the actual range of human experiences covered by such terms. Finally, I invite researchers, administrators, and teachers to contribute toward the fulfillment of these predictions (Suhor, p. 32).

In the passage just quoted, "administrators" appeared between "researchers" and "teachers." This is a symbolic representation that it is the administrative level educator whose responsibility it is to mesh effectively the knowledge of computer technologists and the expertise of teachers to create learning environments which include computers.

Sarason's Concept

"When two or more people come together in new relationships over a sustained period of time in order to achieve certain goals," a setting has been created (Sarason, p. 1). Sarason discusses creation of settings in a lengthy book which discusses administrative or leadership activities in such circumstances. Much of the entire book would apply to what school administrators have done, are doing, or will be doing in connection with computer programs.

> Once a setting "starts," all kinds of things begin to happen or have to be done. A building may have to be planned and built, or some space may have to be found, or rented, or renovated. Personnel may have to be located, interviewed, hired. Various kinds of materials have to be procured. Rules, regulations, and policies have to be formulated, if only because they have to be communicated to prospective employees and clients. Financial resources have to be garnered, budgeted, and spent. Who will do what, who will be responsible to whom, and what kind of timetable will be set for accomplishing this and that are questions that are asked and receive some kind of answer. All of this takes place and is

> perceived in relation to primary and secondary goals which are in the immediate and distant future. (Sarason, p. 61).

The above paragraph might be paraphrased by a school administrator as follows:

Once the computer program setting starts, all kinds of things begin to happen or have to be done. Space in the building must be planned, and since buildings can't be expanded, something has to be relocated or removed. Personnel may have to be trained, persuaded, and reassigned. Rules, regulations, and policies have to be formulated to guide staff duties, class schedules, distribution of software, and distribution of limited resources to assure that both staff and students can function without confusion. Financial resources have to be garnered from the central office, a fund-raiser, or the PTA; a spending plan must be designed to include a plan for apportioning funds between equipment and software as well as a plan for deciding how to divide resources between the new computer program and the traditional programs such as the purchase of library books. Who will do what, who will be responsible to whom, and what kind of timetable will be set for accomplishing this and that are questions that are asked and receive some kind of answer.

Educational leaders are forced to adopt some sort of administrative stance. Most have no option about whether to be involved; the choice concerns the quality of their involvement. Sarason suggests that the administrator should manage the setting by carefully forming a core group, by planning the use of resources, and by making decisions which are consistent with an articulated value system.

Sarason wrote about the creation of a setting; and in a sense, administrators are creating settings for computer programs. Therefore, the Sarason framework is applicable. However, computer program settings are always created within organizations which already have a history. Consequently, the administrative backdrop should include principles to guide administrators who are not in entirely new settings, who already have core groups, and whose resources must be apportioned between the new computer setting and the established remainder of the setting. From a number of possible frameworks, the Blake-Mouton paradigm provides an appropriate framework by which to examine administrative attitudes in an established setting.

The Blake-Mouton Concept

Blake and Mouton discuss administrative effectiveness in terms of concern for task and concern for people. They offer a visual representation of

their concepts in a two-dimensional grid with the x-axis measuring concern for people in a nine-increment scale and the y-axis measuring concern for people in the same way (Blake, p. 12). Administrators who are highly task oriented sometimes lack concern for the people whose cooperation is needed to accomplish the desired task. On the other hand, administrators who have deep concerns about people may focus on personal relations at the expense of accomplishing goals.

Though administrators may be creating new computer program settings, they may be adding to established organizations where it is highly important to achieve a proper balance between concerns for tasks and people. Computer programs do not function independently of other components of their environment. Similar schools with comparable computer equipment and software could have very different computer programs. Administrative decisions have a strong influence on the application of a pervasive new media; therefore, general administrative literature has been surveyed in the preparation of this research.

Computer Program Setting

Computers can be viable educational tools; they can also be entertaining diversions. The setting in which they are used determines what they will be. The computer becomes a tool rather than a diversion when

effective administrative precedures direct its use toward the achievement of specific curricular effective administrative precedures direct its use poorly displayed. Good lighting and a well-chosen frame can, however, enhance the painting. So it is with a computer. Its technological capability is the same whatever its setting. Teamed with thoughtfully developed administrative practices and curriculum goals, computers can be effective educational tools.

Computer Program Considerations

Having reviewed literature to guide in the establishment of a curricular and an administrative framework by which to make decisions, the researcher proposes now to report systematically and selectively on literature specific to computers and computer programs. Four topics will be examined: potential, limitations, cautions, and curriculum principles.

Source of Computer Literature

Aside from books and articles on administrative and curriculum topics, this dissertation references approximately 200 computer specific journal articles. Many of the articles are cited from their original sources in the bibliography; others were in recently published anthologies and are not cited individually. Since a number appeared in publications which do not identify authors, and since many had multiple authors,

there is not a one-to-one correspondence between articles and authors. One hundred and forty-nine writers are specifically identifiable, and in many instances they were identified by position as well.

Eighty-one are connected with colleges and universities. Twenty-seven are representatives of a variety of organizations. Some of the organizations with which the writers are connected are computer or software firms. Others are members of research organizations, and still others are with periodicals or foundations. Nineteen of the writers are identified as educators with city, county, or district school systems. Most of this group work in large city systems; and although their specific titles vary greatly, position names indicate system level administrative positions. Two of the writers have positions similar to the system-level personnel but at the state level.

Eighteen of the writers could not be clearly identified by position, so they are categorized as "unknown." Most of the articles whose authors could not be firmly identified as to position had originally appeared in publications which ordinarily include by-lines with their articles. Therefore, one could reasonably assume that many of this group are staff

writers for the publications which carried the original articles.

Thus one hundred and forty-seven of the one hundred and forty-nine writers have been identified. Of the remaining two, one is a teacher and the other is a principal. Those who influence decision making via print media are not those who experience curriculum (the total impact of the school environment on the learner) at the grass roots level.

Broad reading reveals several recurrent themes related to each of the four selected areas--potential, limitations, cautions, and curriculum. Points will be selected only if they can be supported by multiple citations to indicate that they are generally accepted in current literature.

Potential

1. Computers cannot be manipulated but are popular with students.

> Anyone using microcomputer programs, no matter how "user friendly," soon learns that computers do exactly what you tell them to do rather than what you intend. This does encourage attention to detail and is given as one possible reason why some children gain more from computer based instruction than others (Tessmer, p. 8).
>
> Computers are private, patient, unangered, and bias-free (Weller, p. 150).
>
> Users are motivated and maintain interest over sustained periods of time (Tolman, p. 26).

> Among the computer's most valuable potential contributions are its ability to motivate and keep student interest high. Research conducted to date has indicated that student reactions toward certain subjects have been positive in nearly every case as a result of computer use. Excited by its ability to individualize instruction, students see the computer as a useful educational tool, which they consider to be friendly (Tolman, p. 19).

Among the potential advantages of computer assisted instruction is the machine's unyielding consistency. The student who gives only haphazard attention to instructions soon learns that computers respond only when directions are followed carefully. The computer does not distinguish between personality types. A pleasant student cannot wheedle extra help--or forgiveness--from a computer, and a rascal cannot browbeat the machine into submission. Though mechanical rigidity may be frustrating at times, some pupils benefit from experiences where success depends entirely on performance and where they cannot manipulate circumstances by the power of their personality whether it be positive or negative.

2. Computers can add a new dimension to the instructional program.

> Given the microcomputer's strengths--color graphics, sound, entertainment, record management, and personal user control--by the 1990s computer-assisted learning will begin to compete seriously with books (Baker, p. 42).

> Given usual class sizes and conventional teaching methods, it is virtually impossible for <u>any</u> teacher--even the best teachers--to

> involve all students constructively in relevant learning processes throughout the school day. Computerization and electronic technology, properly selected, can aid the teacher in this regard (Snelbecker, p. 52).
>
> The majority of software marketed for schools is geared to the elementary level and built around the premise that microcomputers can be cost-effective means of increasing the rate at which students learn rules of arithmetic computation and proper English language usage. (Tolman, p. 7).

Color, graphics, movement, variety, novelty, speed, prompt feedback, personalized format, and convenience are some of the attributes of software which can broaden the dimensions of instructional programs. The present state of the art is probably only a hint of the capability that will eventually be developed. Classroom computer stations usually consist of a microcomputer, monitor, and disk drive. Additional peripherals, the creativity of software publishers, and the imagination of teachers are other avenues by which computers can expand the dimensions of instruction.

3. Computers can increase the effectiveness of instruction.

> CAI can assist learners in attaining specified instructional objectives (Tolman, p. 10).
>
> During the next decade, schools will gradually shift from a teaching/learning model based almost exclusively on human instruction to a new approach that combines teachers and machines.

> Current application to instructional modes seems to be virtually unlimited and holds increasing promise for instruction in the cognitive domain. (Weller, p. 149).
>
> A study by Cox and Berger found that students who use microcomputers show positive growth in their attitude toward school work, self control, and tasks involving problem-solving skills (Weller, p. 151).
>
> Its [the computer's] potential lies in its capacity to complement the instructional process by providing self-paced personal instruction with immediate feedback, alternative tutorials, patient skill-building activities, and extension of enrichment experiences (Schwandt, p. 32).
>
> Computer-assisted instruction offers individualized self-paced instruction for a wide range of educational and training functions (Rogers, p. 7).
>
> It appears that many of the repetitive aspects of teaching fundamentals are capably handled by computer-assisted instruction (Good, p. 141).
>
> ...seven ways computers bolster learning: active learning, individualized instruction, feedback and reinforcement, opportunity for success, lowered frustration, motivation, classroom management (Williams, p. 44).
>
> The most striking potential of computer-assisted instruction is its promise for individualized instruction (Suppes, p. 30).

Computer programs which are already in use can increase the effectiveness of instruction. At the lowest level of learning, computers can offer endless randomized drill work, math facts for instance, affirm correct answers, offer help for items missed, repeat items answered incorrectly, and keep a record of

responses. Lacking computer capability, the teacher would have to spend time preparing material to provide the needed practice. The branching feature of many software programs allows students to advance to higher levels as their responses indicate readiness. The adaptability feature of certain programs enables the teacher to insert material from current text material or lectures. A multiple choice format can be a social studies lesson today and a health lesson tomorrow, and formats can be as varied on the screen as on paper.

The above examples are indicative ways that computers can increase instructional effectiveness using software and equipment already common in school rooms. Designers continue to develop more and more sophisticated software and peripherals--combining video disks with computers, for instance--while at the same time making their use less technical. In addition prices are decreasing as markets expand. Computer technology is increasing the effectiveness of instruction.

Limitations

1. Computer programs are expensive to initiate and maintain.

> Teachers, library media specialists, counselors, and administrators have been inundated with recently developed microcomputer software being marketed for use on their schools' new equipment. But nonstandardization of hardware and software,

> the high costs involved, and the extreme variability in the quality of available software pose tremendous selection problems for educators (Truett, p. ix).
>
> The data on microcomputer sales from the Market Data Retrieval survey showed that in 1980 home sales amounted to $120 million; school sales amounted to $35 million. Estimates for sales by 1985 were $475 million for home, $145 million for school. These kinds of data indicate that computer use in the schools is already widespread and will continue to grow rapidly in the years ahead (Baker, p. 22).
>
> It doesn't take a genius to realize that the exploding school market, where sales are projected to top $1 billion by 1987, is being eyed lustily by software manufacturers ("Software Sellers Court the Schools").

The initial cost of computer equipment is considerable; and unless accompanied by ample software, the computers are ineffective. When a school system creates a considerable computer inventory, the maintenance budget becomes significant. If maintenance is from an on-the-scene technician, the cost is in dollars; if from an outside source, the cost is in both dollars and down time. Computer programs necessitate staff development, funding for which may be with new money or by rearranging priorities concerning already available allotments. In addition to fiscal resources, computer programs require an investment in time. Someone must be responsible for creating and maintaining enthusiasm, selecting equipment and software through informed judgements, and making all

the physical arrangements for computers and students to come together in a satisfactory learning environment.

2. Software is not of consistently high quality.

> Although a large and robust body of research on the use of the computer in the classroom shows it to be an effective instructional tool at all levels of instruction, vendors continue to stress the "bells and whistles" approach to selling computers and software rather than attending to the features which research shows to be instructionally effective (Futrell, p. 13).
>
> Courseware packages are frequently developed in pragmatic or "artistic" fashion, without any systematic statement of objectives or analysis of the learning tasks required (Cohen, p. 9).
>
> Many of the claims concerning computer applications in the classroom are unjustified or overblown, and most of the apparently realistic potential applications remain dreams rather than realities for now because of inadequate or inappropriate software development, unacceptable costs in time and trouble as well as money, or other practical problems (Brophy, p. 28).
>
> The area of microcomputer educational software is disorganized and largely centered around a cottage industry lacking standards, quality control and direction. Programs vary widely in quality and the accompanying documentation (instruction for use) is often inadequate (Grady, p. 116).

School offices are awash with catalogues offering software. Only a few years ago there were no educational software publishers; now there are hundreds. Suppliers have rushed to the marketplace with hastily produced products. Software is often more show than substance, and otherwise competent educators

sometimes lack the discernment to choose wisely from a crowded field.

3. Computers cannot replace people.

> As a tutor, the computer teaches its user. An example is computer-assisted instruction (CAI). At its best, CAI can manage instruction as well, by keeping records of student progress and by prescribing lessons for subsequent study. In this mode the computer is intended to complement the classroom teacher, not replace that teacher (Baker, p. 29).
>
> Though we share the belief that the computer will ultimately have a greater impact on education than anything since the invention of the printing press, we do not believe that it can effectively replace the responsive, sensitive, enthusiastic teacher or the shared insights and collective dynamics of peer-group interation (Sheingold, Micro Use, p. 32).
>
> The school of the future is waiting to be created. We have the technology and intelligence. Now we need the passionate and practical vision to determine how best to use the available technological and human resources for our human success (Camuse, p. 325).

Computers are one hundred percent accurate, and they thrive on dull repetition. Fatigue does not affect them, and they do not observe holidays and vacation schedules. However, teachers have human qualities such as responsiveness, insight, and concern which computers cannot duplicate. Even if computer scientists perfect "artificial intelligence" which is already in the experimental stage, it will remain

artificial. Human beings will continue to direct and manage the machines. Computers cannot replace people.

Cautions

1. Technology is not a panacea.

> Although the new technology staggers the imagination and offers exciting opportunities, it is well to remember that it offers no guarantees. The computer is only a tool; educators must face the challenge of using its full potential. People are still in control and will determine its use. Therein lies the opportunity as well as the challenge (Tolman, p. 27).
>
> Simply because a computer is used to present the instruction is no reason to believe that the instruction is better than any other (Kulik, p. 28).
>
> Technology, in and of itself, is neither an educational innovation nor a passing fad (Weller, p. 149).
>
> These innovations wil not constitute a panacea for education but, if properly used, they can become extremely valuable aids to teachers and students (Snelbecker, p. 52).

Movie projectors, sound recordings, television receivers, and video recorders have all had periods of popularity. Expectations have exceeded realization for all of them. However, each has, after a period of experimentation, settled into a situation of usefulness for educators. Today's technology is not a panacea. If history continues to repeat itself, the novelty will wear off and computers will be accepted matter-of-factly as one more tool with which teachers work.

2. Selection of software requires careful attention.

> Two dangers must be avoided if we are to gain maximum benefits from microcomputer instruction. First, instructional software must go beyond a skill and drill, electronic workbook approach. Secondly, instructional software must be developed to become an integral part of the curriculum, not just an "add on," gamelike activity (Wangberg, p. 385).
>
> A great deal of valuable professional time is spent attempting to identify good courseware within an extremely large body of available computer programs (Futrell, p. 13).
>
> The Educational Products Information Exchange report noted that there is a greater need for software that can teach critical thinking, problem solving, and higher-order skills, such as application, analysis, synthesis, and evaluation (Baker, p. 23).

Educators lack experience and self-confidence in selecting software; and to complicate the situation, the market is flooded with options, many of which are of doubtful quality. Even further complication arises from the fact that selection standards vary. Another factor to be considered in software selection is the circumstance in which the material will be used. A program that might be effective in a computer lab directed by a technically skilled teacher might not be appropriate for use by a classroom teacher who has one computer as an interest center in a corner of the room. A program that might be very useful for a group of low-achievers in a given grade would not necessarily be a good choice for an abler group at the same grade

level. Selection of software requires careful attenion. The optimum condition would be for a teacher to review prior to purchase and choose software for a particular use in a particular setting.

3. Non-educators may have too strong an influence on educational decisions.

> Relevant data on software come from teachers who have used the programs, not from manufacturers' representatives (Brophy, p. 30).
>
> Ignorance of computer technology, according to Klassen, 'breeds vulnerability and places the destiny of education at the mercy of the technologists. There then enters the risk that the technology will shape education, whereas in fact education should shape the technology to suit its needs' (Truett, p. 4).
>
> Since the microsoftware publishing business is in its infancy, many of those who are engaged in the publication of instructional materials lack requisite skills both in instruction and in the management of appropriate evaluation activities designed to have informational value for the user and to provide a basis for revision and modification of the software (Steffin, p. 20).
>
> ...Despite increased pedagogical piety and prayer, a critical lacuna remains--the intelligent participation of the teacher (Rubin, p. 299).

Non-educators produce software and salespeople wield influence in placing it in schools. Much of it is not designed to fit curriculum objectives, and it is not always field tested with students prior to marketing. Computer literature expresses greater concern about the quality of software than about any

other feature of computer programs. Extensive dialogue between educators and technologists would reduce the influence that non-educators have on educational computing.

Curriculum

1. Computer programs should be fitted to the learner.

> Persons who have taught the target population in an interactive, dialogue mode are the ones best qualified to judge the suitability of courseware for that group (Steinberg, p. 17).
>
> Responses that require extensive typing, for example, are not appropriate for children or adults who do not know how to type...A lesson that is too slow and repetitive for normal children may be exactly right for slow or disabled learners (Steinberg, p. 18).

It is important that software be developed with assistance from practicing educators and field tested with the target population. Until the target group interacts with the material, the producer will not know how students will interpret directions or questions. Reading ability is an important consideration in every program. A program intended to help with beginning math skills is useless if directions require an advanced reading ability. Single-keystroke responses are faster and simpler for the user, but spelled-out answers assure deeper involvement with the material. Graphics hold the attention of some pupils but delay,. distract, or bore others. The development of software

is a complex procedure, but software should be fitted to the learner.

2. Field testing is essential to the production of effective software.

> All computer and/or computer/video programs should, upon completion of the development phase, be validated by pilot testing the lesson with a minimum of three students (Rogers, p. 6).
>
> No matter how qualified the reviewers, whatever their profession, they do not know if a lesson really works until they have tried it with students for whom it is intended. What the lesson 'can' do for students is not necessarily what it actually does (Steinberg, p. 19).
>
> Feedback for correct responses in the form of clever graphics and animation are rewarding for some groups but a bore and a nuisance for others. Those most able to judge these aspects of courseware are people who have experience teaching the target population. Intelligent "others," such as content experts are not necessarily aware of what the target learners already know about the subject. A subject matter expert or someone who has simply lectured in a subject cannot anticipate the concepts students will find most difficult, or will not understand at all (Steinberg, p. 18).
>
> Evaluation should determine whether activities are appropriate to the concepts to be taught, are appropriate for the age of the student user, call for reasonable tasks on the part of the user, serve as an appropriate medium for the content, and are attractive and interesting (Steffin, p. 21).
>
> Far and away the highest priority for study is curriculum impact (Rockman, p. 14).

Being an expert in a subject field does not assure that one will perceive correctly the difficulty level

or type of activity that would be helpful to a student at a given grade. Sometimes a student responds in a way the producer never anticipated and the program stalls. The user must then spend his allotted computer time waiting for assistance or must re-start the program. In either case, loss of student time and computer time have occurred, losses which might have been prevented by field testing. Interest level, pacing, reading level, and content validity are some of the other features of software that might be investigated during field tests.

3. Computer use, like all teaching activities, should fit objectives.

> Microcomputers are just one means, albeit a powerful one, to help students learn what your school system already has decided they should learn (Parker, p. 42).
>
> The essential component of any instruction, whether it be delivered by teacher-student interaction, print materials, or electronically mediated modalities, is the degree to which measurable changes, modifications, or additions to the learner's behavior may be identified. Given this view, implementation of an evaluation strategy is achieved through rigorous use of carefully specified instructional objectives (Steffin, p. 21).
>
> Judgements about any computerized or electronic innovation (or, for that matter, any educational innovation) should not be made in the abstract. Rather, decisions about their initial selection and about their continued use should be made with regard to particular computerized innovations in the context of the ongoing program and the local school characteristics (Snelbecker, p. 52).

Computers have gained great popularity within a short time span; therefore, there has been a tendency to assume value merely for interacting with the equipment. Users can learn about computers or with them, but in either case the instruction should be planned and purposeful. Classroom activities are chosen for a variety of reasons. Sometimes the purpose is specifically for the purpose of increasing knowledge or understanding of a traditional subject. The purpose might be to pique interest, to change pace, to enrich, or for any of a multitude of reasons. Computer activities should be treated like all others: selected to promote a previously selected objective. Teachers curb aimless browsing or doodling during paper and pencil activities or during lectures. Computer activities warrant the same quality of professional supervision.

4. New technology requires creative adaptations by educators; however, don't jump on the band wagon if you don't know where it's going.

> To be functional, school resources must match the setting in which they offer instruction (Instructional Uses, p. 2).
>
> For a variety of reasons, it appears that educators are, more often than not, wed to considering curriculum innovations in terms of traditional course structures (Brody, p. 32).
>
> Putting a machine, albeit a powerful and engaging one into a classroom is unlikely by

> itself to have a positive effect on children and teachers (Sheingold, Micro Use, p. 413).
>
> Educators aren't rushing out to buy more computers right now, nor are they rushing to buy more software. They're pausing, re-evaluating, and deciding on new directions for computing. We encourage them to move computing in a direction that puts the power of the computer into enhancing education, rather than let it become an end in itself (de Peyster, p. 6).

Placing a computer in a classroom is not likely to change procedures very much unless staff development occurs, unless appropriate software is available, and unless the teacher senses that supervisors attach importance to the program's success. Regardless of the planning which precedes implementation of a new activity, computer or otherwise, surprises will occur. The teacher needs the security of knowing that while successes will be applauded, shortcomings during experimentation will be tolerated. When any new element is introduced into a setting, initial interpretation is likely to be in terms of a familiar framework. Sometimes it is very difficult to think of new ways to make schedules, utilize space, or allocate resources. New technology requires creative adaptations by educators, but novelty, per se, has no value. Thoughtful pre-planning is the raw material to which creativity can be added to bring exciting new programs into being.

Table 1

Recapitulation of Recurrent Themes
from Computer Literature

Potential

1. Computers cannot be manipulated but are popular with students.
2. Computers can add a new dimension to the instructional program.
3. Computers can increase the effectiveness of instruction.

Limitations

1. Computer programs are expensive to initiate and maintain.
2. Software is not of consistently high quality.
3. Computers cannot replace people.

Cautions

1. Technology is not a panacea.
2. Selection of software requires careful attention.
3. Non-educators may have too strong an influence on educational decisions.

Curriculum

1. Computer programs should be fitted to the learner.
2. Field testing is essential to the production of effective software.
3. Computer use, like all teaching activities, should fit objectives.
4. New technology requires creative adaptations by educators; however, don't jump on the bandwagon if you don't know where it's going.

Convergence of Technology and Pedagogy

In addition to the common themes enumerated above, there is another which appears repeatedly in current computer literature. It addresses the ways computers are used. Sometimes the focus is on the choices teachers make of activities for pupils. Sometimes the focus is on the software that is available. Whatever the emphasis, the point of the recurring theme is that computers are too frequently used for drill and practice. Disdain is sometimes emphasized by the use of terms such as "electronic workbooks," "electronic page turning," or "skill and drill" Wangberg, p. 385). A typical comment is "If a school has a lab without some really knowledgeable people, the machines probably will be underused or misused--most often for mere drill and practice" (Klein, p. 217).

Writers frequently refer to thinking skills or higher order thinking skills. "Many educators feel that we should concentrate on developing thinking skills and devote less time to mechanical techniques" (Deringer, p. 25). Another writer comments that "most learning takes place at low levels of taxonomies of learning" (Tessmer, p. 9).

Computer literature often lists modes of learning or types of software as Drill and Practice, Tutorial, Simulations, Problem-solving, and Games. These

designations are somewhat related to Bloom's hierarchy, but not entirely so. The first four proceed from most elementary to most advanced in terms of thinking skills, but the Games category is separate. Games attract players for a variety of reasons not all of which are related to learning or thinking skills.

What the literature recommends and what teachers accept and use are not the same. This investigator has not found a better published description of the difference between theory and practice than the following:

> Although many educators laud the appearance of computer-based courseware that encourages creative and abstract thinking, not all classroom teachers have jumped on the bandwagon. In fact, according to Bodie Marx, vice president of Mindscape Inc., of Northbrook, Illinois, something like a battle line has been drawn between computer coordinators, who have been assigned to schools to assess software needs, and classroom teachers, who are faced with actually executing the new programs. Marx...notes the growth of "tension" between the two camps and suggests that those products aimed strictly at development of higher-order thinking are likely to be rejected at the classroom level.
>
> To the concerns some teachers have about integrating critical-thinking skills software into the curriculum, Dr. Alfred Bork of the University of California at Irvine adds another: namely, that some problem-solving programs are so sophisticated that only 1 percent of the population can use them. Dr. Bork, who is developing software to teach junior-high students how to think like scientists, suspects that the students who can use the most advanced programs would

> probably be good critical thinkers anyway--even without the software (McKibbin, p. 55).

Chapter Summary

This chapter began with a survey of curricular and administrative literature which created a framework within which to consider specific literature about computers and elementary computer programs. Several generalizations were drawn concerning potential, limitations, cautions, and curriculum. Each generalization was supported by two or more citations from current literature to illustrate each point. Biographical information was tabulated to demonstrate that published material does not originate in schoolrooms. Finally, attention was directed to the purported weakness in computer programs and software, namely that the mental stimulation is generally too low. The survey of the literature has set the stage for presentation of primary research data collected from the certified elementary school personnel in Henderson County, North Carolina.

CHAPTER III

ANALYSIS OF FINDINGS

This chapter will report the findings from an opinion survey conducted during the last two months of the 1985-86 school year among the certified personnel in the elementary schools of Henderson County, North Carolina. Responses were sought from all certified personnel which include, in addition to classroom teachers, media specialists, physical education teachers, music teachers, guidance counselors, reading specialists, and special education teachers from several different areas of exceptionality. Every elementary level certified employee except principals was invited to participate in the survey.

Description of the School System

Location and Population

Henderson is a mountain county with a public school population of approximately 9,000 pupils, about half in elementary school. One primary and nine elementary schools serve grades kindergarten through six and feed into three consolidated junior highs, grades seven through nine. Each junior high transfers pupils to a companion senior high for grades ten through twelve. The county system serves pupils from a number of suburban developments, from rural areas, and from several industrial sections of the counnty. A separate city system serves urban youth. Socio-economic and

academic levels are similar from school to school in the county as indicated by the fact that federal programs for the disadvantaged have traditionally been spread fairly evenly throughout the system. Achievement test scores and the distribution of exceptional child population, both low- and high-achievers, further support the fact that schools throughout the system are more alike than they are different.

Disbursement of Funds

All general funds, both state and local, are distributed among schools on the basis of average daily membership. This applies to monies such as instructional supplies and library funds. Only when funds are designated for a particular population such as the disadvantaged does a school receive resources on a basis other than its membership. In addition to the usual state allottments, Henderson County pupils receive local funds annually to the extent of $22.00 per pupil. Of this amount, $7.00 per pupil is for library and $15.00 per pupil is for other projects and programs.

Since categorical state funds have recently been available for computer programs, principals have been requested to use only the designated monies for equipment, software, and peripherals. Some parent-teacher groups have supplemented state funds; but, by-and-large, computer programs have been operated with state funds. Henderson

County's computer program is typical in that recent financial resources have been similar to other systems, atypical in that, because of several years of added local support, computer media may represent a smaller proportion of total resources than in some systems.

Computer Inventory

Elementary schools in Henderson County had 144 Apple computers in the system at the time survey data were collected for this research. The following chart shows the distribution of equipment in relation to student population:

Table 2

Distribution of Equipment and Courseware

School	Membership*	Number of Computers	Number of Diskettes
Atkinson	396	10	53
Balfour	553	19	193
Dana	475	16	165
East Flat Rock**	333	10	157
Edneyville	552	18	86
Etowah	448	19	237
Fletcher	472	20	258
Hillandale	381	11	121
Mills River	518	16	26
Tuxedo	194	5	86
Totals	4322	144	1382

*Membership information comes from attendance reports; data concerning computers and courseware come from end-of-year media reports.

**East Flat Rock School includes grades four through six and Hillandale includes grades kindergarten through three. Both schools are in the same community and together function as a K-6 elementary unit.

Administrative Policy Regarding Computer Program

An immeasurable, nevertheless influential, feature of a school system is the aura of the workplace. Though many aspects of the local educational enterprise are structured, considerable latitude is arranged for individuality among schools. A statement from the Board of Education's North Carolina State Accreditation Plan (1984-85) indicates that elementary schools have been unhampered in the discovery process concerning computer applications:

> The curriculum at the elementary school level is characterized by its diversity arising from two general conditions: (a) there is presently no written curriculum; (b) the elementary schools have had microcomputers for only a very short time...Furthermore, the teachers at the elementary level have been encouraged in this diversity as a unit-wide experiment to determine the more effective means of utilizing microcomputers with young children.

This information is presented to establish more clearly the setting from which the survey information arises. Although nearly three-fourths of the staff have participated in locally sponsored orientation, the course was not a platform from which official philosophy, overt or implied, was presented. Whatever opinions emerge from the survey represent individual, professional judgements.

In many areas, selection of software, for instance, individuality among schools occurred merely because that option was available. Circumstances, however, influenced decisions in some buildings. Because of space limitations,

some principals had little choice except to place computers in classrooms; other less crowded facilities had the option of assembling their computers in lab situations. The following chart shows where computers are located in the elementary schools.

Table 3

Location of Computers in Henderson County Elementary Schools 1985-86

School	Classroom	Media Center	Laboratory	Other
Atkinson	8	2		
Balfour	15	1		3
Dana		14		2
East Flat Rock	4	2		4
Edneyville	14	4		
Etowah	18			1
Fletcher	18	2		
Hillandale	7	3		1
Mills Rive			12	4
Tuxedo				5
TOTAL	84	28	12	20

One Henderson County school reports 12 of 16 computers in a laboratory setting. Another reports 14 of 16 computers in the media center, an arrangement which, in essence, creates a laboratory setting in the media center. This means that 20% of Henderson County's elementary schools have a laboratory. The Johns Hopkins University study reported in June of 1986 that 32% of the elementary schools in their survey had computer laboratories (Instructional Uses, p. 7).

The Johns Hopkins study used 2,361 U. S. public and non-public elementary and high schools as a stratified sample to project the national percentage reported in that study.

Staff Qualifications

Payroll records indicated that there were 257 certified staff members in the school system at the time the survey forms were distributed by building principals. The 207 usable responses which were returned represented an 80.54% return. Only thirteen unusable questionnaires were returned; some were blank and carried notes that the respondents did not use computers while others were completed incorrectly.

Although some staff members did not respond because of unfamiliarity, there is no administrative policy which deters any staff member from using computers. Some certified employees--speech therapists and guidance counselors, for instance--indicated by their responses that because much of their work is with individuals or very small groups, they have not chosen to use computers. This information is included to illustrate that county administrators have not applied pressure to restrict use. This school term is only the third since the first computers were placed in elementary schools in the county, so it is entirely possible that software is not yet available for every specialty. Since software selections are made at the

building level, software would not be uniformly available throughout the system.

Overall, the return rate is sufficiently high to be accepted as representative of the opinions of the elementary staff. Three other factors might further account for the approximately 20% who did not respond. First, there may have been other teachers--physical education and music, for instance--who felt they lacked informed opinions. Second, teachers are busy people, and some probably overlooked the deadline quite unintentionally. Third, survey responses were sought during the same time period when many elementary personnel were deeply involved with activities related to implementing the new state promotion standards.

The following chart addresses the qualifications of the respondents to the survey in terms of experience and level of certification.

Table 4

Chart to Summarize Credentials and Experience of Survey Participants

Years Experience	"A" Certificate	"G" Certificate	Total
0- 5	29	4	33
6-10	36	16	52
11-15	30	27	57
16-20	20	19	39
20+	19	7	26
	134	73	207

The above information indicates that the median experience of the respondents to this survey is in the 11-15 year range and that 35% of them have graduate degrees. By comparing survey data to information contained in recent state and Southern Association self studies, it can be determined that the respondents to the survey are comparable to the entire staff in regard to training and experience. Statistical data available from the Division of Certification, North Carolina Department of Public Instruction, for the 1984-85 school year indicate that statewide the median experience level is in the 11-15 year range and that 33% of certified personnel have degrees beyond the bachelors. Respondents to the survey are equal to the entire state in experience and slightly higher in earned degrees. The opinions tabulated in this survey are from experienced, well-qualified teachers who typify the entire system.

As a part of the survey, teachers were asked to indicate specific training they have had in the computer area. Of the 207 who responded to the survey, 153 have taken a 30-hour, locally sponsored, computer orientation course. In addition 31 have had word processing courses of the same length in programs compatible with the county's equipment. Answers in the "other" training category indicate that some teachers have had computer courses in connection with graduate studies; some have had specific

courses in the use of Bank Street Writer, a word processing program appropriate for elementary student use; and others have attended non-credit workshops. Three of the ten elementary schools have planned and conducted in-house renewal activities for teachers, further adding to the accumulated expertise of the total staff.

Description and Results of the Survey

Participants were directed to examine twenty-five items which they might perceive as limitations for an elementary computer program, choose the five they considered the most descriptive of their feelings, and rank them. The directions specified that a rank of five be used for the item they viewed as most limiting, four for the next most limiting, down to one for their fifth and final choice. This had the effect of allowing each respondent to register fifteen units of intensity (5+4+3+2+1). A copy of the survey as it was presented appears in Appendix A. The items, ranked from most to least intense by accumulated totals, appear below. 207 participants, each distributing 15 units of intensity, divided 3105 total units among 25 offered items or composed "other" items.

Table 5

Accumulated Raw Scores
for Factors which Limit Elementary Computer Programs

580	Teacher lacks time to plan and prepare meaningful computer experiences for pupils.
297	Time for pupils to use computer(s) is limited.
287	Only one or two pupils can use a computer at a time.
266	Teachers lack time to supervise class on computers.
173	Schedule is difficult to work out for computer use.
156	Manuals require too much time to read and understand.
136	Supply of software is inadequate.
127	Software and equipment does not allow entire class to work on a program together.
126	Teachers need a specialized person to teach computer class.
118	Students need computer instruction.
117	Children who are not using computer are diverted by those who are.
108	Some programs use too much student time with graphics and credits and allow too little time for students to give curriculum-related responses.
103	Software available to me does not meet needs of the varied subjects I teach to my class.
95	Children miss group activities while at the computer.
79	Software available to me does not meet needs of varied levels of pupils in my class.
61	Computers require teacher time that could be better spent on other instructional duties.
38	Software available to me is too much like workbooks or ditto sheets.
31	Some software programs are not helpful in teaching.
26	Computer programs do not meet the needs of my weaker students.
22	Programs emphasize drill and practice too much.
19	Software incorporates too many skills in the same program.
17	Programs require too many higher order thinking skills.
15	Some pupils do not like to use computers.
7	Computers require too much technical knowledge from the teacher.
3	Computer programs do not meet the needs of my better students.
98	Miscellaneous (Options not exercised by some respondents and items written in "other" category.)
3105	Total units of intensity (equal to 15 units x 207 participants)

The second and last portion of the questionnaire requested opinions concerning things teacher perceived as potentially helpful. By asking for responses to limitations in one section and for potentially helpful things in the other, the researcher sought to get candid opinions both from those who might have positive feelings and those whose attitudes might be negative. All answers, including a few written comments, appeared to have been offered as business-like responses.

Twenty-two items were offered in the section concerning potentially helpful things. An "other" category was also offered for those who might wish to suggest completely different things. Participants were asked to select five items, assign a rank of five to the item they viewed as the very most positive, four to the next most, down to one for fifth choice. Items with accumulated units of intensity follow.

Table 6

Accumulated Raw Scores for Potentially Helpful Factors for Elementary Computer Programs

283	Help from a resource person who is already familiar with specific software
270	Someone to teach class in a lab situation so students could do computer activities in groups
269	Someone to locate existing programs or to write programs to help with specific learning objectives
267	More opportunity to preview and adapt programs prior to using them with pupils
257	Programs by which pupils can review lessons which have been coverd in texts and lectures
231	More access to computers
206	Ability to put more students on computers at the same time
186	Programs correlated to subjects
164	Someone to teach computer
144	More software to help with "basics"
114	More opportunity to review software before purchase
106	Someone to assist in preparing data for programs that can be adapted by the user
100	More programs with capability to individualize levels and keep class records
97	More programs that make the student the "do-er" not the "receiver" e.g. Logo and Turtle
84	More training in the use of word processing programs
69	More access to computers with printers
63	More opportunity to select software for purchase
59	More commercial software
47	Programs which present material randomly such as math facts or states and capitals
39	More training in the use of commercial software
21	More access to word processing programs
3	Teacher learning the keyboard
26	Miscellaneous (Options not exercised by some respondents and items written in "other" category
3105	Total units of intensity (equal to 15 units x 207 participants)

Numerical data are more comprehensible when presented in a percentile format. Both raw score tables have been converted into percentile tables and are presented below.

Factors which Limit Elementary Computer Programs

100	Teacher lacks time to plan and prepare meaningful computer experiences for pupils.
51	Time for pupils to use computer(s) is limited.
49	Only one or two pupils can use a computer at a time.
46	Teachers lack time to supervise class on computers.
30	Schedule is difficult to work out for computer use.
27	Manuals require too much time to read and understand.
23	Supply of software is inadequate.
22	Software and equipment does not allow entire class to work on a program together.
22	Teachers need a specialized person to teach computer class.
20	Students need computer instruction.
20	Children who are not using computer are diverted by those who are.
19	Some programs use too much student time with graphics and credits and allow too little time for students to give curriculum-related responses.
18	Software available to me does not meet needs of the varied subjects I teach to my class.
16	Children miss group activities while at the computer.
14	Software available to me does not meet needs of varied levels of pupils in my class.
11	Computers require teacher time that could be better spent on other instructional duties.
7	Software available to me is too much like workbooks or ditto sheets.
5	Some software programs are not helpful in teaching.
4	Computer programs do not meet the needs of my weaker students.
4	Programs emphasize drill and practice too much.
3	Software incorporates too many skills in the same program.
3	Programs require too many higher order thinking skills.
3	Some pupils do not like to use computers.
1	Computers require too much technical knowledge from the teacher.
1	Computer programs do not meet the needs of my better students.

Potentially Helpful Factors for Elementary Computer Programs

100	Help from a resource person who is already familiar with specific software
95	Someone to teach class in a lab situation so students could do computer activities in groups
95	Someone to locate existing programs or to write programs to help with specific learning objectives
94	More opportunity to preview and adapt programs prior to using them with pupils
91	Programs by which pupils can review lessons which have been coverd in texts and lectures
82	More access to computers
73	Ability to put more students on computers at the same time
66	Programs correlated to subjects
58	Someone to teach computer
51	More software to help with "basics"
40	More opportunity to review software before purchase
37	Someone to assist in preparing data for programs that can be adapted by the user
35	More programs with capability to individualize levels and keep class records
34	More programs that make the student the "do-er" not the "receiver" e.g. Logo and Turtle
30	More training in the use of word processing programs
24	More access to computers with printers
22	More opportunity to select software for purchase
21	More commercial software
17	Programs which present material randomly such as math facts or states and capitals
14	More training in the use of commercial software
7	More access to word processing programs
1	Teacher learning the keyboard

Context of the Survey

In the previous chapter representative leaders in the area of curriculum and administration were cited to create a backdrop against which to examine computer-specific literature. This approach was in recognition that planning for computers is not independent of other considerations. When computers are placed in schools, they appear within a context; they relate to other aspects of school life. Just as it was important to examine computer literature within a framework of administrative and curricular theory, so it is necessary to interpret survey results within a framework. This researcher submits that of all the motivators which guide teachers, the two most powerful influences are achievement tests and performance appraisal instruments.

When educators focus their attention on an individual student, they examine individual achievement scores. Should Johnny be retained? Should Billy be screened for an exceptional child program? Is Mary's current progress similar to or different from her past performance?

When educators focus their attention on planning, curriculum design, or evaluation, they look at averages, usually medians. In fact grade level medians are routinely reported by system and by school as part of the state mandated test program in North Carolina; and even though it may be largely self-imposed, teachers do feel pressure to raise class medians.

The teacher appraisal instrument mentions students--specifically plural--in a number of items. In others the implication is clearly present that successful evaluation depends on how the teacher performs in relation to the entire group. Phrases such as the following illustrate the point: "gets students on task quickly," "monitors the behavior of all students," "assigns tasks that students handle with a high rate of success," "check all students' performance," "treats all students in a fair and equitable manner," and "questions that students handle with a high rate of success."

Certainly teachers are subjected to many other influences, and many of these influences urge individualization. However, achievement tests and the performance appraisal instrument are such compelling influences that they are the pole stars. Teachers can, and assuredly do, succeed with a multitude of secondary goals and objectives; but a primary focus is on managing a classroom group to get the greatest possible gain on achievement tests by median scores.

Teachers did not think just of computers when responding to the survey questions. They thought about the computer as a tool that might be used in a group setting. All elementary school activities are under the direction of teachers. This includes breaks, meals, and physical activity as well as formal lessons. Furthermore,

kindergarten and first grade teachers supervise groups who have little or no reading skills.

Having created a context, the author will now make a narrative interpretation of the survey data.

Observations Concerning Limitations

Time Constraints

Teachers overwhelmingly chose the statement "Teacher lacks time to plan and prepare meaningful computer experiences for pupils" as their top concern. The word "time" appears eight times in the "limitations" section of the questionnaire; and in addition to the strong weight they gave to the first-choice item, their second, third, fourth, and sixth ranked choices also concerned time. To further underscore the notion that concerns about time are uppermost in teachers' minds, the fifth ranked item related to schedules--another time-related consideration.

Software Constraints

Several items on the "limitations" list refer to software. The survey results reveal that teachers' next concern after time is the quantity of software. They placed these items in seventh and eighth positions in terms of rank order. They registered ten times as much concern about planning time as for the quality of software. They assigned low values to items which alluded to software quality, e.g. "Software available to me is too much like workbooks or ditto sheets," "Some software programs are not helpful in

teaching," and "Computer programs do not meet the needs of my better students."

Limitations of Minimal Significance

Nine items out of twenty-five registered a concern level of less than ten on a scale of 1 to 100. Concern that computer programs are like workbooks or ditto sheets is minimal, and concern is even less that programs emphasize drill and practice too much. As a group, the survey respondents registered the lowest possible concern for programs that do not meet the needs of better students. According to the results of this survey, teachers have very mild concern about the quality of software.

There are two possible reasons for teachers' low level of concern about software quality. One possible explanation is that the most common kind of software--drill and practice--is the most useful to teachers who are primarily concerned with raising medians on achievement tests in an orderly group setting. Another possible explanation is that teachers are far less sophisticated in judging software than in judging other tools of their trade.

The median experience for respondents to this survey was 11-15 years. This would mean that the average teacher who participated in the survey would have taught through two adoptions of each basal texts. He/she would have had opportunity from experience to form opinions about texts.

He/she would not have the same breadth of experience with software.

General Conclusions on Limitations

The survey indicates that the highest level of concern is lack of time to plan and prepare meaningful computer experiences for pupils. A possible interpretation of this could be that teachers are influenced by computer anxiety. However, the survey also shows that teachers expressed very little concern for the technical knowledge computers require of the teacher. Since the survey indicates a very high level of concern about planning time while showing a very low concern about technical knowledge requirements, it is reasonable to conclude that their chief concern, planning time, is literal and straightforward. (Henderson County does adhere to state regulations concerning a duty-free period daily, so teachers' time constraints are probably typical of rural districts. Some systems might not have similar early morning and late afternoon buses.)

If a teacher wishes to familiarize herself with a resource in printed format, she can take it home for examination at her leisure in the evening or on the weekend. Not so with a computer program. Although most software comes with printed documentation, the reading of the manual is near meaningless unless it is studied while also trying the program on a computer. In addition to the fact that print media are more portable than computer programs,

teachers have a wealth of experience in reacting to print format. Many conventions are similar on a near universal scale. Page numbering, the use of bold-face or italic print, paragraph indentions, table of contents, and an index are but a few examples of formatting aids that enable a teacher to plan and prepare for the use of print materials.

Planning time is a high priority item with teachers for several reasons. It must be done where the computer is located. Program documentation is lengthy, and it may be couched in unfamiliar vocabulary. Software publishers, unlike book publishers, do not observe a system of universal conventions to assist the teacher in limiting preparation time.

The factors which account for the significance teachers attribute to planning time are likely to persist. However, teachers' reactions to these pressures may change as they move beyond their present two-year level of exposure. Just as a musician who joins a new group may need extra preparation time while mastering a repertoire or a new librarian might falter temporarily in a new setting, teachers might lack initial ease in directing computer activities. Even adequately trained teachers need practice to achieve a comfortable level of efficiency.

Observations on Potentially Helpful Things

Computer Specialist to Augment Instruction

Teachers did not reach a decidedly strong concensus on a single item which they deem most helpful. Converted to a scale of 100, the scores are distributed fairly evenly throughout the 100-interval range. In the first section of the questionnaire they selected lack of planning time as the chief limitation; and, by their responses to the second part, suggested three ways to improve the situation: help from a resource person who is already familiar with specific software, someone to teach class in a lab situation, and someone to locate or write programs to help with specific learning objectives.

Preview and Evaluation of Software

Three of the potentially helpful items concern professional examination of software, and the range of scores is significant:

94 More opportunity to preview and adapt programs prior to using them with pupils

40 More opportunity to review software before purchase

22 More opportunity to select software for purchase

Teachers express only mild interest in the selection of software, moderate interest in reviewing it before purchase, but strong interest in previewing and adapting the material before using it with pupils. County administrative and purchasing procedures probably influenced these responses.

A long-standing policy in Henderson County has encouraged teacher participation in the selection of materials. Also, each school has a functioning media advisory committee. The seemingly low interest in the selection of software does not indicate insouciance; rather it indicates that they are already participating in the selection process.

To protect themselves from unauthorized copying, producers are often less than fully cooperative in allowing purchasers to preview materials before purchase. Teachers may be saying that the school system has not provided adequate opportunity to preview before purchase, but on the other hand they may be saying that preview is made difficult by the vendors.

The strongest response rests with the item which suggests more opportunity to preview and adapt programs prior to using them with pupils. The score of 94 registers a clear message. Once software has been placed in the media collection, teachers definitely want to preview it before they use it.

The overall implication of the entire survey is that teachers feel that weaknesses and pressures could be relieved with additional personnel. The survey questions inquired only about the computer program, not about other pertinent areas which would have to be considered before actually adding staff members. For instance, if a computer

specialist were added, would that help still be needed after a few years when elementary teachers develop their expertise more fully? If not, what problems would administration face in phasing out the position? The author feels that the survey responses represent sound, professional opinions. However, for a program which has such broad implications, two years is probably too short a time for teachers to have developed opinions which are also mature.

Word Processing

Three items on the "potentially helpful" list refer to word processing capabilities. All three of them registered a level of concern at 30 or below. In fact, the survey registers a level of only 7 on the item, "More access to word processing programs." Only 31 survey respondents indicated they had had training in word processing, and half of these had taken a course in AppleWorks, a program which is not efficient except with computers which have been especially equipped to expand their memory capacity. Only a few computers have been modified in this way, so trained personnel do not always have access to appropriate equipment to use the particular word processing skills they have.

Bank Street Writer is the most widely distributed word processing program for elementary age pupils, and every school in Henderson County has several copies of this software. It was placed in the schools just this year, and only one school offered formal training in the use of this

program. Teachers responded to the questionnaire with minimal exposure to a student level word processing program.

Although there are 143 computers in the elementary schools, there were only 38 printers at the time teachers completed the survey instruments. Of that number, 22 were placed in the schools during the second semester of the current school year. Therefore, teachers who responded to the survey have had limited exposure to word processing training and to printers which make the procedure meaningful. Increased opportunity and training might change teachers' level of concern about items related to word processing.

Summary of Findings

By their responses to both sections of the opinion survey, elementary teachers in Henderson County indicated their interest in more time to prepare, more help, more equipment, and more software. The survey does not reveal at what level they would feel their equipment and software needs were met. Nor does it reveal how they would feel about assistance if they had supplies they deemed adequate.

As was stated earlier in this dissertation, "The practitioner easily becomes locked into behavior patterns" (Brubaker, p. 179). Teachers feel that the "schedule is too difficult to work out for computer use," that "software and equipment does not allow entire class to work on a program together," that "children who are not using computer are

diverted by those who are," and that they need the "ability to put more students on computers at the same time." In terms of rank-order position, each of these items appeared in the top half of the respective lists. One must at least consider the possibility that these responses do not reflect a mind set toward "alternative views (perceptions) of time and space" (Brubaker, p. 179). One must also consider that the survey respondents are experienced practitioners, and their apparent preference for maintaining the status quo may be valid. Traditional group activities may be the most efficient way to meet teachers'--and society's--goal of higher median test scores. Whatever the interpretation, the present study indicates that teachers prefer a computer program format which preserves traditional inclass group activities.

Teachers indicated by their responses a greater interest in the content of software than the quality of the programs. They indicated a strong interest in "programs by which pupils can review lessons which have been covered in texts and lectures," and in having "someone to locate existing programs or to write programs to help with specific learning objectives." On the other hand, they did not register strong feeling about "programs that emphasize drill and practice too much," the lowest order of thinking skills, or about programs that "require too many higher order thinking skills." Achievement tests measure pupils' mastery

of content. Teachers evaluate materials and educational tools in terms of their helpfulness in achieving content objectives.

Teachers gave weak response to the statement that "computers require too much technical knowledge from the teacher," and "computer programs do not meet the needs of my better students." The low level of concern for these items indicates that teachers are confident of their ability to use the equipment and that they are more concerned about selecting materials for weaker students than for high achievers.

This chapter has reported on a teacher opinion survey in Henderson County, North Carolina. One part of the next chapter will present tentative recommendations in response to the specific problems and weaknesses identified by the teachers. The purpose of the recommendations will be to stimulate thought and to alert planners to the broad implications of computer programs. Another part of the succeeding chapter will suggest areas for further research. Computers do not just share a setting; they force interaction. These interactions, occurring while computer programs are in their formative years, if examined according to standard research methods, can influence the future effectiveness of educational computer use.

CHAPTER IV

SUMMARY AND CONCLUSIONS

As stated earlier in this dissertation, public school programs have frequently been shaped by visionary leaders who can look beyond what is to see what might be. Since schools exist to serve the needs of the community, it is fitting that visionary leadership come from a variety of sources--legislators, business leaders, higher education, and technologists, to name a few. It is from sources such as these that a body of literature is developing, a representative portion of which has been reviewed in this dissertation. The message from this literature is quite clear: public schools are not using computers as effectively as they might.

The primary research data for this dissertation comes from the entire elementary teaching staff of Henderson County, and the tabulated results indicate that teachers' concerns are very different from those expressed in current literature. Writers are concerned that computers are being used in ways that are too elementary. Teachers, on the other hand, unabashedly use computers for drill and practice and register their concern over lack of time and equipment.

To ask which group is right is to ask the wrong question. A more productive line of inquiry is to ask why teachers and writers have different points of view and

whether both could be valid. This investigator's conclusion is that they have different views because they have different perspectives. Those who write about computers have more exposure to computers and computer ideas than teachers have. For them--the writers--computers are the reality and classrooms of children are an abstraction. On the other hand, reality for a teacher is a group of children whose activities require careful planning and direction.

The vast majority of writers cited in this research project are not associated on a regular basis with children in classrooms. Their expertise lies in their knowledge of computer technology. They can expand the horizon of educators by describing anticipated capabilities of computers and by suggesting more effective ways to use the equipment, software, and technology presently available.

Teachers' expertise lies in their skill in incorporating an additional, relatively unfamiliar, media into the classroom. Certainly the potentiality exists for using a computer to elevate some pupils beyond the knowledge level of learning, but teachers are aware--and their opinion surveys reflected this awareness--that classroom management encompasses far more than directing the learning of one or two children at a computer. Elementary staff members expressed their opinions within the context of their teaching situation. They attach more importance to planning

time, scheduling, and equipment inventory than to higher order thinking skills and sophisticated software.

Since public school computer programs are relatively new, viewpoints will likely evolve from both educators and journal writers. This chapter will mention ten areas in which improvements might be made and will suggest eight areas in which productive research might be conducted.

> Where new knowledge and understanding will take us is not predictable. It is hard to accept the fact that the more you know the more you need to know and that it is an endless process that does not end in a utopia. There will always be problems. This is the consequence of all new knowledge just as it should be part of the perceived reality of all those who create settings today and dream of future societies (Sarason, p. 284).

Since each component of a setting interacts with others, improvements should be tailored to the unique needs of a specific situation. Therefore, this writer offers suggestions for improvement tentatively. Elementary school computer programs are at this writing still in the formative stage. Data gathered by carefully conducted research methods could be invaluable to "those who create settings today and dream of future societies."

Areas for Possible Improvement

Plan Appropriate Inservice

Systems should offer appropriate inservice opportunities in the computer area. As teachers move beyond the awareness level in their training, they develop more

specialized interests. Some feel a need for training in word processing. Some become interested in utility programs, and others like to master programs which allow them to adapt software to include the same material they are covering in textbooks and lectures. Teachers are motivated to participate in inservice activities which carry certificate renewal credit.

Arrange Practice Time for Staff

Some systems allow teachers to take computers home during the summer and/or during longer vacations such as Christmas and spring break. The Johns Hopkins research project discovered that one advantage of placing computers in classrooms rather than laboratories is that teachers use computers more if they are in classrooms (Instructional Uses, p. 8). The operation of a computer, like swimming, bicycle riding, or driving a car, is a motor skill which improves with practice. By arranging convenient staff access, school systems can probably raise the level of staff interest and computer effectiveness.

Encourage Entire Staff to Develop Computer Skills

Whether computers are in classrooms or a laboratory, all teachers need to be involved in computer assisted instruction. It is the classroom teacher who can best decide what learning experience would be most profitable for a given student. Only if the teacher is informed about computers and available software can he/she decide whether

the most appropriate learning experience would be via computer rather than some other media.

If one staff member becomes the school's computer specialist, then some other performance may be curtailed to allow time for extensive computer teaching. If the librarian, for instance, becomes the computer specialist, then story time or library skills lessons may diminish. Such a choice should be made by a calculated plan rather than by default or accident.

Promote Demonstrations

Software operation is more quickly learned from demonstration than from reading manuals, and enthusiasm is sparked by people rather than printed media. The learner will not fully master a piece of software from a demonstration but will get a general grasp of it. The use of printed documentation for detail will often follow demonstration, but teachers appreciate an opportunity to learn by doing rather than by reading.

The particular teacher who initially recommended the purchase of a piece of software will likely become an early user and a prospective demonstrator. Sales representatives are often capable demonstrators though not always sound educators. (The author recently attended a demonstration by a sales representative who efficiently ran a vocabulary program and explained the procedure. She did not know, however, the total number of vocabulary words from which the

program made random selections or whether the company could provide teachers with a printed list of program contents.)

Should demonstrations spread enthusiasm among several teachers, those who finalize requisitions should be prepared to make decisions about multiple copies of one program versus individual copies of several programs. Teachers are unlikely to sustain their enthusiasm for a program that is not readily available.

Watch for the Teachable Moment

Though teachers may intellectually accept the presence of computers and recognize the implications of the information age for schools, habits change slowly. Those who function at the planning level have not completed their task by placing a computer in the hands of a teacher. The equipment becomes effective only through use. Therefore, planners should be alert for the "teachable moment" when a teacher might be ready to revise old behavior patterns to include computers in lesson plans. There is often a precise opportune moment when perceptive leadership can translate concept into curriculum change.

The author observed a teacher who just didn't find time to use her new computer for many days. Eventually she mentioned that a group of her pupils needed extra help in learning the use of guide words to develop dictionary skills. When a program for that precise skill was offered at the exact moment of need, she happily used it and began

consciously to include the computer as an available resources in her planning.

Accept Diverse Use Patterns

Some competent teachers use overhead projectors almost every day; others who are equally competent rarely use them. The same applies to the use of other tools--filmstrips, maps, math manipulatives, and even chalkboards. Similar patterns should probably develop eventually concerning computer use. At this time, however, there is a public sensitivity to computer access. Schools may consider the clock more than academic needs in apportioning computer time.

As schools accumulate greater inventories of equipment and research data, they will be able to schedule computer time on the basis of educational need rather than by a mathematical formula. It is not too soon to consider questions such as whether first and sixth graders should have equal access and whether the expense of computer drill for slow learners is justified. The ultimate goal should be for intelligent, productive, not necessarily equal use.

Bridge the Communication Gap

Most people who have developed expertise in the area of computer technology have not had direct experience in teaching young children. Many have only a cursory understanding of the skill sequences which are the warp and woof of elementary teaching. On the other hand, elementary

teachers often lack sufficient understanding of computer capability and vocabulary to articulate their needs to computer experts. A communication gap exists which should be narrowed. Elementary computer programs would profit by the input of educators who are competent in both elementary education and computer technology.

Relieve Anxiety Concerning Fragility of Computers and Software

Teachers feel the responsibility for the equipment in their care, and they are sometimes anxious about the fragility of computers and disks. As teachers observe an accumulation of weeks and months of trouble-free use, their concern about fragility diminishes; but verbal reassurance from an authority figure may speed the time when a teacher will use equipment freely. Teachers may benfeit by knowing details about local maintenance plans, warranties, and spare parts. They will use equipment more freely if they understand that down-time is anticipated and planned for.

When teachers participate in the selection process for software, they become aware of the initial cost of programs. If a program is listed at $100 in the software catalogue, the teachers assume that $100 is being risked each time a student works with the disk. Their concern can be alleviated by informing them that replacement cost is generally far less than initial cost. Equipment and

software deserve reasonable care but they can withstand reasonable use.

Provide Appropriate Material

Computer software like other teaching materials should be appropriate for the situation in which it is to be used. Teachers work more enthusiastically and effectively with materials they feel is appropriate. If they participate in the selection process, they are more likely to use the software which is eventually purchased.

Media specialists can provide teachers with software evaluations from such sources as the State Department of Public Instruction, professional journals, and producers; but these outside agencies do not know an individual teacher's unique circumstances. The location of computers in the building, the time frame within which a teacher has access to computers, a concentration of slow learners or gifted pupils, the previous computer experience of teacher and pupils, and learning objectives are some of the unique features which might influence a teacher's choice of software. Materials should be placed in a room because they are deemed appropriate by the teacher.

Allow Participatory Planning

Computer plans should evolve from the staff; they should not be imposed in an authoritarian way. Some decisions--what brand of computers to purchase or how to arrange security--require more information than teachers

have time to gather. Decisions by computer-wise administrators are appropriate in such cases. Other decisions--what subject areas can best be improved by software expenditures or how to share limited equipment--deserve the attention of those most qualified to assist, the teachers. Appropriate teacher participation in planning raises both enthusiasm and the quality of decisions.

Table 9

Recapitulation of Possible Areas for Improvement

Plan Appropriate Inservice
Arrange Practice Time for Staff
Encourage Entire Staff to Develop Computer Skills
Promote Demonstrations
Watch for the Teachable Moment
Accept Diverse Use Patterns
Bridge the Communication Gap
Relieve Anxiety Concerning Fragility of Computers and Software
Provide Appropriate Material
Allow Participatory Planning

Areas for Research

Effect of Computers on Types of Learners

Schoolrooms contain a variety of learner types. Mainstreaming practices assure that a typical classroom group might include educable mentally handicapped, learning disabled, academically gifted, and/or other types of

exceptional children. Children in these categories are not casually designated; they are certified as such according to very specific state guidelines. Pupils who do not meet the criteria for any exceptional child program range from slow learners to near gifted.

In addition to the fact that pupils vary widely in their ability to learn, they learn according to varying modalities. Learners may respond to visual, auditory, or kinesthetic stimuli--or a combination. Motivation and emotional state are among the other factors which influence learning.

Research should attempt to determine which types of learners benefit most from which types of software. The level of technology is sufficiently refined to produce many kinds and levels of software. It remains for educators and researchers to determine how best to use computers with pupils of widely different styles and abilities.

Number of Responses per Unit of Time

Many software programs begin with imaginative graphics to present the title of the program. Sometimes the producer's and author's names appear for several seconds on the monitor. When software is programmed in this way, the user is forced to wait for the introductory frames to run their course before beginning to interact with the material. To force computer users to focus attention repeatedly on title and credits is equivalent to requiring pupils to focus

their attention on cover design and title page for several seconds before each use of a text.

Software producers often employ time-consuming graphics after each response to a question. If a graphic routine is programmed into software, it decreases the number of responses a student can give during a given amount of computer time. That which is an effective attention getter may, upon repetition, become a distraction.

Research might reveal how best to use graphics. One of the touted advantages of computers is the capability of offering immediate feedback. Research might determine how to make the feedback both immediate and appropriate.

Time/Equipment Relationship

Many school districts have only a small inventory of computers; others, of course, have greater numbers. Fairly soon after launching a computer program, a school system faces decisions about allocation of funds. To what level should basic computer inventory be raised before diverting funds to peripherals?

One illustration will demonstrate the need for further study in the area of time/equipment relationships. A popular theory is that word processors can be used effectively to improve writing ability. The reasoning behind this theory is that revising by computer removes the handwriting drudgery and makes the writing process more appealing to students. However, if pupils reach an upper

elementary level which has the printer to make the word processor meaningful but has come from a lower grade which had no computer, he may lack effective keyboarding skills.

Even when a system's computer program is in its infancy, decisions must be made concerning the relationship that will be arranged between time and equipment. Funds must be allocated to basic equipment, software, peripherals, maintenance, staff, and staff development. Whatever amount is spent in one area decreases the amount available for the others. Many theoretical decisions have been made. Comparative studies might discover which theories are more accurate.

Location of Equipment

Some schools place their equipment in classrooms; others assemble theirs in computer rooms. Though not clear-cut, computer literature tentatively endorses the "lab" setting. Part of the ambiguity in the literature arises because writers who favor "labs" are often discussing instruction about computers rather than the use of computers for computer-assisted instruction.

Further research is indicated before the question of location is settled. Research should examine the level of training of the entire staff in connection with the best setting for equipment. If only one competent computer teacher is assigned to a school or if one computer enthusiast emerges on a school staff, the situation is

different from a school where the entire staff is interested in computers and has access to the equipment.

If computers are placed in a laboratory setting and a teacher offers computer assisted instruction on a group basis, then the individualizing feature of computers is lost. If, on the other hand, all the pupils in a class load and run different programs then it becomes quite difficult for the teacher to monitor the performance of all members of the group. Research in the area of location should evaluate the efficiency and the quality of computer time in both classroom and laboratory settings.

Many colleges are now including computer courses in their teacher training programs, and within a few years entry-level teachers will have had computer experiences even in high school. Although some current teachers will take only required inservice, others will seek additional training. Location should not be investigated as an isolated feature. That aspect should be studied in relation to other features such as staff training.

Media Specialist's Role

General computer literature is largely silent concerning the role of media specialists in computer activities. However, this researcher has observed in his own locality that several elementary librarians have become more deeply involved than most other staff members in computer programs. Since record keeping is such an

important function of a librarian, and since computers make record keeping so much easier, it is perhaps natural that elementary school librarians would be among the first to become computer enthusiasts. In addition, professional literature and workshops encourage librarians toward automation. In the process of learning about computers for the purpose of maintaining the collection, a media specialist may automatically become the most expert member of the staff concerning computers in general. The important role of librarians in the computer program is fostered, too, at the state level by the fact that one department is designated "Media and Technology Services."

As librarians reallocate more of their time to computer program responsibilities, they allocate less time to other duties. Research should be conducted to investigate optimum library services in the elementary school. Librarians should not be assigned computer program responsibilities by default. If librarians curtail traditional activities to assume responsibility for computer programs, the change should be guided by research and planning.

Research Specifically for Elementary Schools

Since much current literature discusses the quality of software, the implication is that computers are used frequently for computer-assisted instruction in content areas. Some school systems, however, put considerable effort into teaching elementary pupils about computers with

emphasis on Logo and BASIC, two widely used programming languages. The theories upon which such plans are based should be tested through research.

As equipment inventories increase, elementary schools confront the question of whether to distribute equipment evenly throughout the grades or to put a greater concentration in some grades than in others. Schools place building blocks in kindergartens and encyclopaedias in intermediate grades. Decisions about computer placement are not so obvious as decisions about building blocks. Intelligent decision-making requires research specifically for elementary age pupils.

Keyboarding Skills

A great deal of information needs to be gathered on keyboarding skills. Several producers offer software programs purported to teach these skills. However, educators should determine through their own investigations when pupils' maturity and physical development is sufficiently advanced to master typing skills. Educators should also investigate the effect of keyboard familiarity on the use of word processing programs in the upper elementary grades. (The author intends a clear distinction between touch typing skill and keyboard familiarity.) Several questions suggest areas for profitable research: At what level should pupils learn touch-typing skills? Should keyboard proficiency, like driver training, become a

universal curriculum goal? Is a word processing program a more effective tool for teaching composition if pupils are familiar with the keyboard? What effect does casual keyboard use have on pupils when they enroll in high school typing classes? Do pupils become proficient typists if their instruction is via a software package? If society assumes that the automobile is a universal part of life and teaches everyone to drive, should a similar assumption be made concerning efficient use of a keyboard?

Influence of Staff Training on Computer Programs

Educators who engage in computer research should be careful to consider the staff members' level of expertise and interest when conducting research or when interpreting their findings. Consider a hypothetical situation. Two schools are the same size and have the same equipment inventories. The staff at one school has had little training and no one has piqued their interest. At the other school teachers have been encouraged to experiment with the equipment; they have participated in the selection of software; and they have discovered that computers are far less fragile and mysterious than they had originally thought.

Staff attitudes and experiences should be investigated and reported along with research findings. Likewise, these characteristics should be considered when making application of research data.

Table 10

Recapitulation of Suggested
Areas for Research

Effect of Computers on Types of Learners
Number of Responses per Unit of Time
Time/Equipment Relationship
Location of Equipment
Media Specialist's Role
Research Specifically for Elementary Schools
Keyboarding Skills

Conclusions

The primary research for this dissertation reported the opinions of elementary teachers in Henderson County, North Carolina schools after two years of computer use. Although the data come from a system still in the formative stage of computer program development, the information is nevertheless significant because educators are dealing with the "relative newness of the [computer] technology in education" on a national scale ("Transforming Education," p. 61). The data from Henderson County is like a snapshot. The action was not interrupted, but a moment was captured for reflective examination. Another chapter surveyed current literature and reported a synthesis of opinions from reputable published sources. One generalization emerges from thorough consideration of the survey data and careful study of related literature: Teachers' concerns are prosaic and practical; writers' concerns are global and conceptual.

Both groups recognize the impact computers have had on society and the implications for change in the education environment. Only their perspectives are different.

Teachers see first their pupils and an array of materials, one of which is a computer. They focus on learning objectives for a particular subject or age group, and the future is tomorrow--a day when pupils may need activities on such mundane topics as dictionary guide words, plural endings, math drill, and spelling the months. They are academically aware that computers have far greater potential; but, as teachers, their expertise lies in their ability to choose the right tool--however simple--at the right time. They have developed their technical skills only to the level needed to function at their grade level.

The writers, these visionary leaders unhampered by the presence of twenty-five children, see first the possibilities. The future is more than twenty-four hours away and a computer is far too grand for use as a drill master. Their expertise lies in their advanced technological skill and their ability to articulate ideas.

Just as pragmatists and visionaries by incremental steps created the automotive age, so will they cause the computer age to occur in education. Pragmatists saw the automobile as a way to broaden employment and shopping opportunities; visionaries saw the need for auto plants and highway systems. In education, pragmatists will see

immediate needs and applications while imaginative leaders will envision and exploit potentialities.

Effective educational leadership in the computer age requires skills commensurate with the times. Not only must one be well grounded in educational psychology, curriculum theory, and administrative techniques. The strong leader will possess also at least a theoretical, if not a technical, knowledge of computers. Only the perspicacity which accrues to the well informed will be sufficient for the leader who will effectively influence both the pragmatists and the dreamers, the immediate and more distant future.

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APPENDICES

APPENDIX A

Questionnaire Used as Pilot Test for Survey Instrument

TEACHER OPINION SURVEY

Grade level_____
Years experience __0-5; __6-10; __11-15; __16-20; __20+

Computer training:
(check all that apply to you)

_____I have had a computer orientation course for 3 units of renewal credit.
_____I have had a course in the use of AppleWriter
_____I have had a course in the use of AppleWorks.
_____I have had a course in BASIC programming.
_____I have had a course in Pascal.

List other training you have had:

_____

_____

What limitations do you perceive in the use of computers as aids to instruction?

(Please choose the five statements which most nearly express your perception of limitation. Give your strongest feeling a rank of #5; your second strongest a rank of #4, etc. down to #1.

_____Only one or two pupils can use a computer at a time.
_____Manuals require too much time to read and understand.
_____Computers require too much technical knowledge from the teacher.
_____Programs emphasize drill and practice too much.
_____Programs require too many higher order thinking skills.
_____Computer programs do not meet the needs of my better students.
_____Computer programs do not meet the needs of my weaker students.
_____Children miss group activities while at the computer.
_____Software available to me does not meet needs of varied levels of pupils in my class.
_____Software available to me is too much like workbooks or ditto sheets
_____Software available to me does not meet needs of the varied subjects I teach to my class.
_____Some software programs are not helpful in teaching

_____Some programs use too much student time with graphics and credits and allow too little time for student to give curriculum-related responses

_____Lack of time for teacher to plan and prepare meaningful computer experiences for pupils

_____ _____

_____ _____

Which of the following things would help you most in using computers more effectively?

(Please choose the five items which best describe your perception of potentially helpful things. Assign a rank of #5 to the item you think would be the most helpful; #4 to the item you think second most helpful, etc. down to #1.

_____More commercial software
_____More access to computers
_____More access to computers with printers
_____More access to word processing programs
_____More training in the use of commercial software
_____More training in the use of word processing programs
_____Help from a resource person who is already familiar with specific software
_____More software to help with "basics"
_____Programs which present material randomly such as math facts or states and capitals
_____Programs by which pupils can review lessons which have been covered in texts and lectures
_____Someone to assist me in preparing data for programs that can be adapted by the user.
_____Someone to teach my class in a lab situation so students could do computer activities in groups
_____Someone to locate existing programs or to write programs to help me with specific learning objectives
_____More opportunity to select software for purchase
_____More opportunity to review software before purchase
_____More programs with capability to individualize levels and keep class records

_____ _____

_____ _____

APPENDIX B

Cover Letter which Accompanied Survey Instrument to Teachers

Dear Fellow Educator:

In connection with graduate work I am doing at UNC-Greensboro, I would like to conduct a survey of elementary teachers concerning the use of computers. Responses will be anonymous. The information from the survey will compare attitudes and opinions of elementary teachers with suggestions and philosophies which appear in professional literature. I shall, of course, try to identify similarities and differences.

During the early part of this school year, I did another research project in which I examined computer curricula from a number of other North Carolina school systems. My information indicates that our local unit is ahead of a number of others in terms of equipment, software, training, and experience. Therefore, I feel that a survey from this unit will be meaningful.

I realize this is a busy time of year and every moment is important to you so I would like to express sincere thanks to everyone who responds.

Sincerely,

Frederick E. Taylor

Your principal has agreed to collect these forms and put them in my box at the county office.

APPENDIX C

Opinion Survey Instrument for Elementary Teachers of Henderson County, North Carolina

TEACHER OPINION SURVEY

Grade level___
Years of experience: __0-5; ___6-10; __11-15; __16-20; __20+

Circle the type certificate you have: "A" "G"

Computer training (check all that apply to you):

_____I have had a computer orientation course for 3 units of renewal credit.
_____I have had a course in the use of AppleWriter.
_____I have had a course in the use of AppleWorks.
_____I have had a course in BASIC programming.
_____I have had a course in Pascal.

List other training you have had:

_____

_____

What limitations do you perceive in the use of computers as aids to instruction?

Please choose the five statements which most nearly express your perception of limitations. Give your strongest feeling a rank of #5; your second strongest a rank of #4, etc. down to #1.

_____Only one or two pupils can use a computer at a time.
_____Manuals require too much time to read and understand.
_____Computers require too much technical knowledge from the teacher.
_____Programs emphasize drill and practice too much.
_____Programs require too many higher order thinking skills.
_____Computer programs do not meet the needs of my better students.
_____Computer programs do not meet the needs of my weaker students.
_____Children miss group activities while at the computer.
_____Software available to me does not meet needs of varied levels of pupils in my class.
_____Software available to me is too much like workbooks or ditto sheets.
_____Software available to me does not meet needs of the varied subjects I teach to my class.
_____Some software programs are not helpful in teaching.
_____Some programs use too much student time with graphics and credits and allow too little time for student to give curriculum-related responses.
_____Teacher lacks time to plan and prepare meaningful computer experiences for pupils.
_____Software and equipment does not allow entire class to work on a program together.
_____Supply of software is inadequate.
_____Students need computer instruction.
_____Teachers need a specialized person to teach computer class.
_____Teachers lack time to supervise class on computers.
_____Software incorporates too many skills in the same program.
_____Children who are not using computer are diverted by those who are.
_____Schedule is difficult to work out for computer use.
_____Some pupils do not like to use computers.
_____Time for pupils to use computer(s) is limited.
_____Computers require teacher time that could be better spent on other instructional duties.

_____ _____

_____ _____

Which of the following things would help you most in using computers more effectively?

Please choose the five items which best describe your perception of potentially helpful things. Assign a rank of #5 to the item you think would be the\most\helpful; #4 to the item you think second most helpful, etc. down to #1.

_____More commercial software
_____More access to computers
_____More access to computers with printers
_____More access to word processing programs
_____More training in the use of commercial software
_____More training in the use of word processing programs
_____Help from a resource person who is already familiar with specific software
_____More software to help with "basics"
_____Programs which present material randomly such as math facts or states and capitals
_____Programs by which pupils can review lessons which have been covered in texts and lectures
_____Someone to assist in preparing data for programs that can be adapted by the user.
_____Someone to teach class in a lab situation so students could do computer activities in groups
_____Someone to locate existing programs or to write programs to help with specific learning objectives
_____More opportunity to select software for purchase
_____More opportunity to review software before purchase
_____More programs with capability to individualize levels and keep class records
_____Ability to put more students on computers at the same time
_____Someone to teach computer
_____More programs that make the student the "do-er" not the "receiver" e.g. Logo and Turtle
_____Teacher learning the keyboard
_____Programs correlated to subjects
_____More opportunity to preview and adapt programs prior to using them with pupils

_____ _____

_____ _____