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AN ANALYSIS OF KINDERGARTEN
CHILDREN'S USE OF A WORD
PROCESSOR IN THEIR
PRINT LITERACY
DEVELOPMENT

by

PAUL STEGER

A dissertation submitted in partial fulfillment of the
requirements for the degree of

DOCTOR OF EDUCATION
in
PUBLIC SCHOOL ADMINISTRATION AND SUPERVISION

Portland State University

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TO THE OFFICE OF GRADUATE STUDIES:

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AN ABSTRACT OF THE DISSERTATION OF Paul Steger for the Doctor of Education in Educational Administration presented December 3, 1987.

Title: An Analysis of Kindergarten Children's Use of a Word Processor in Their Print Literacy Development.

APPROVED BY MEMBERS OF THE DISSERTATION COMMITTEE:

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Many young children appear to take delight in manipulating common elements of their environment, e.g., sticks, stones, and mud. Our ancestors also used these and other elements in order to play, explore, and eventually

create written language. In a print-laden society, young children are budding literates. Within a few years their abilities and skills evolve to the level it has taken the human species thousands of years to reach.

Associated with the evolution of written language is related technology. Humans have evolved from cave art and literacy to computer art and literacy. Again, what has taken thousands of years to evolve for the species takes only a few years for today's children. Within the past ten years computers have become common literacy implements in American schools. An understanding of childrens' use of this machine is important to educators in general and educational leaders in particular.

The purpose of this study was to investigate kindergarten students' use of a word processor: What developmental sequences related to print literacy reveal themselves as kindergarten children use a word processor? In what ways are these sequences the same or different than those identified by researchers studying young children's use of pencil and paper? What time commitments do children make at each stage of these developmental sequences? How do the physical attributes of the computer environment, screen color for example, influence children's behavior associated with word processing?

A review of literature incorporated readings associated with research in human evolution of print literacy, literacy

of technology, language and cognition plus recent research on writing and computers.

A research design incorporating qualitative methods was created. Six subjects, representing a variety of backgrounds in a kindergarten class of 26 full day students, were observed for 20 weeks. For one hour each day, this kindergarten class attended a writing lab which contained eight learning centers. One of the learning centers consisted of six word processors networked to two printers. In addition to collecting student documents, both in paper and electronic form, subjects' behaviors were observed and recorded. Observational recordings were analyzed, collapsed into manageable data, and re-analyzed.

Subjects' evolution of writing was similar to children using pencil and paper. In addition, subject's literacy of technology evolved. Each subject displayed individual episodes of development and incorporated less mature behaviors with more mature behaviors as they evolved along their print literacy and literacy of technology continuums. It was observed that subjects intertwined print and technological behaviors and skills as they wrote with a word processor.

Time relationships associated with the development of writing and environmental aspects of the word processor center did not appear important. Information Age etiquette

evolved as students controlled their writing, a computer system, and worked with others. The inherent publicness of monitors contributed to meta-linguistics, sharing knowledge about technology, and problem solving among students.

Young children are capable of writing with and manipulating a word processor. They are also capable of trying to solve problems of written language and computers. Educators will find that young children quickly learn Information Age tool etiquette.

To My Family

ACKNOWLEDGMENTS

Many special thanks to all of the children who have participated in Sabin's kindergarten and grade one classrooms during the last five years. It has been a pleasure watching students blossom as print literate individuals. A special ingredient to their flowering literacy has been their contact with the many excellent members of Sabin's staff. In particular, this study would not have been started or completed without the assistance and cooperation of Carmen Barnett, Brenda Bartell, Yvonne Berry, Kathy Gillaspie, Nancy Gresbrink, Hazel Keasey, Mary Laughlin, Chris Lamp, Lori Oman or principal, Mike Jordan. I also appreciate the insights and support many parents and other professionals have shared during this period of study.

Members of my Dissertation Advisory Committee, Amy Driscoll, Colin Dunkeld, Kelly Hancock, John Heflin, Rosemary Williams and Carolyn Moilanen of Portland Public Schools Evaluation Department have provided much valued assistance, encouragement, suggestions, and guidance. In particular, my advisor, Judy Edwards-Allen has provided continuous support throughout this study.

Finally, special thanks to my lovely family. My children Emily and Zachary have given me many hours to observe and appreciate their literacy growth. Patricia

Ferguson-Steger, my wife, has not only provided much encouragement but has been extremely helpful in so many ways.

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CHAPTER I

INTRODUCTION

A delight for many children attending preschool or day care is finger painting. With special paper and paint, children have license to squash, spread, squeeze and explore this medium. When the spreading medium is pudding or shaving cream, additional senses are involved. Before we had shaving cream, pudding, and finger paint available in our culture, children used mud and other moist material (many still do) for exploring and play. As children grow older and become more sophisticated, they learn about and explore with new media and technologies, e.g., crayons, pencils, or pens on different types of materials, including paper.

Such early play with spreadable media has not always been the sole domain of children. There is evidence, dating back more than 25,000 years, of finger motions with a medium which produced drawings of spaghetti-like motifs on ceilings in caves inhabited by our Cro-Magnon ancestors (Marshack, 1975). Mud play (exploration) by young children and the subsequent drying of this material may be a reflection of our ancestors exploring and creating with a similar media before inventing the technology of clay tablets for record keeping.

Young children evolve from spreading things, drawing, and marking walls to focusing their pictorial and visual media explorations on paper and more culturally accepted forms of expression. This is similar to human evolution as we have moved from cave walls to papyrus to parchment to paper. As the human species has evolved, we have invented, discovered and explored with new media and technologies. As children develop, they invent, discover and explore new media and technologies. Print literacy is an evolutionary component of the human species' growth and development and can also be an evolutionary component of an individual's growth and development. This mirror image of an individual's literacy evolution reflecting our species' literacy evolution is similar to the biological expression "ontogeny recapitulates phylogeny."

It has taken thousands of generations for the human species to evolve to its present state of oral and written language. Today, an individual species member completes his/her language development in one generation. Our ancestor's initial communication may have consisted of non-verbal body language. Soon after and/or in conjunction with body language evolved oral language. Later in our species' evolution there was a need for the invention and development of written communication. This human species evolution of communication is commonly repeated by individual species members today. Except in special cases, each human

has the facility to develop oral and written language capabilities.

Luria (1977/1978) has used the term "cultural skills" in reference to children developing number and letter concepts. In our present society, we use the terms "literate" and "literacy" to connote the ability of an individual or people to understand and use numbers and letters to read and write. In many cultures throughout the world, literacy skills assist people in their daily living (Hall 1959). Of the four billion people populating the earth, over three billion are literate.

According to many authorities, there are four major components to literacy: speaking, listening, reading, and writing (Holdaway, 1979, 1984; Goodman, 1984; Oxenham, 1980; Smith, 1984; Stubbs, 1980). A narrower perspective of literacy I define as print literacy. "Print literacy" refers to the ability to read and/or write cultural symbols (e.g. hearts, rainbows, skull and cross bones, etc.) and language sound symbols (e.g. letters, syllables, words, etc.).

When considering print literacy evolution and the skills necessary for written communication, a question arises of which skill came first, reading or writing? This is similar to the question, "Which came first, the chicken or the egg?" Oxenham (1980) writes: "Although in historical sequence, writing necessarily preceded reading - the code had to be invented before decoding could occur - the latter is much

more widely practised." In the particular circumstance of the development and evolution of literacy, reading and writing, as well as listening and speaking skills, are intertwined, not linear as with the chicken and egg.

Interrelated with the evolution and development of literacy for both the human species and individual members of the species is associated technology. In reference to writing, Oxenham (1980) states: "... the operation demands at least two articles, the material on which the script is to be marked and the instrument with which the marking will be done." In order to produce a literate item, one must have an implement to write with and something to write on and, if necessary, a substance which will leave a mark.

PROBLEM STATEMENT

A major aspect of the evolution of literacy has been development of associated technology. Movement along the literacy continuum is directly related to the invention and development of literacy tools. Earliest tools were composed of items from nature, animal fluids, plant materials, sticks and clay. Through thousands of years of evolution, human visual perception of technology associated with written language products has moved from one of diuturnity, being continuous or lasting, to that of ephemerality, lasting temporarily. Print literacy tools have moved from cave walls and clay tablets to light dots and electronic non-visual

storage. The latest literacy tool associated with the Information Age is an electronic machine, the computer. Computers programmed with word processing software are now being made available for young children to use as literacy tools (Daiute, 1985; Guttinger, 1986; Wallace, 1985).

However, there are those who question this writing tool innovation and freely share their opinions in words and print. In the opening chapter of Computers and Literacy, Daniel Chandler (1985) shares the following conversation:

T: You really ought to use this thing. Once you've picked it up you can stop worrying about not being able to remember things: it does it for you! You'd be amazed at the clever things you can do with it: you'll discover talents you didn't realize you had. And you'll realize how wise you were to try it.

A: It's a fascinating invention. But I'm afraid I've never believed that those who sell an idea are the best judges of its worth. People who use this thing will become dependent on it and soon they'll stop thinking altogether. I know that there'll be lots of people who'll say that anyone who can use it is brilliant, but just owning a way of storing vast amounts of information doesn't make you clever, does it? Will people know how to use it - that's the question? And what kind of world would it be if everyone was dependent on this kind of thing?

S: Exactly. You can't really learn anything from using it: all it can do is tell us what we already know.

P: Quite right.

S: At least if you ask a person something you've a fair chance of having a useful conversation. If we have to use this thing there'll be only one answer to each question, regardless of who asks it and whether they understand the answer. And what about people who abuse the system: how could we protect the information we put into it?

P: I couldn't agree more. (p.1)

Similar conversations have been repeated many times within the past 5 to 10 years. When reading this conversation one may well be struck by the divergent views held by the various speakers concerning their topic of discussion. One notices a definite hesitation by three of the speakers in accepting this new phenomenon. The other speaker appears supportive and shares his/her enthusiasm. Their conversation includes little fact, mostly opinion concerning its use and how it will affect those who employ it. Although this conversation was recorded by Plato almost 2500 years ago, it could easily have been taped within the last decade. In this conversation, a teacher is discussing and rejecting a technology which you, the reader, use at this moment. Socrates is explaining how this new technology will make people stop thinking and that it will ruin their minds. The topic of conversation is written language; the participants are discussing this new technology of the Iron Age.

Similar to today's common hesitation in readily accepting Information Age technology, Socrates and the other participants only speak from their own subjective opinions. Most of today's conversations related to the use of computers, and particularly children's use of computers, are based upon subjective opinion. Bridwell and Duin (1985) write:

While testimonials abound concerning the ways computers have changed people's lives as writers (Nancarrow, Ross, and Bridwell, 1984), we don't yet know whether these changes make them better writers or just better producers of polished manuscripts. We don't know whether computers contribute to new ways of thinking during writing or just new ways of manipulating sentences, paragraphs, and 'files' (p. 115).

Students have had little access to computers and young children even less. There have been very few studies focused upon young children's use of computers and even less centered upon their use of word processors and print literacy. Dillon (1985) shares:

If we wish to learn about the role of computers in child literacy and their effect on children's learning and 'linguaging', we'll need to spend much time in classrooms with children and computers to study closely and carefully what happens there. Despite the amazing degree of interest in computers, I have found very little work describing and analysing what actually happens with them in classrooms, particularly from the sociopolitical context of language and learning ... (p. 102).

Various authorities have written of the Computer Revolution (Information, Telecommunication, Digital Technology, etc. Ages, Civilizations, and Revolutions) rivaling that of the Industrial Revolution (Crichton, 1983; Lias, 1982; Masuda, 1983; Rosenbrock et al., 1981; Toffler, 1980; Vallee, 1982). Others have shared that the invention of the computer may have as vast an impact upon the human species as the printing press (Evans, 1979; McLuhan, 1962; Oxenham, 1980). This is no doubt the first time in human history that society has had forewarning of possible change

due to a radically new technology. The last quarter of the 20th Century is an opportunity for our society to investigate the use of computers (Marien, 1983). In particular, we have the opportunity to investigate children's use of a word processor as they progress along their individual evolving literacy continuums. This research based knowledge will assist leaders in helping to provide direction in education.

It has been suggested that leadership is an imperative component to effective schools (Brookover, Beamer, Elthim, Hathaway, Lezotte, Miller, Passalacqua, & Tornatsky, 1982; National Committee for Citizens in Education, 1980; Sergiovanni, 1984). Further, it has been proposed that principals provide guidance in our nation's schools by assuming a role of instructional leadership (NCCE, 1980). Others support this position; in Becoming a Nation of Readers, the authors (1985) write: "Schools that are especially effective in teaching children to read are characterized by vigorous instructional leadership" (p. 112). At a symposium held early in this decade (NCCE, 1980), it was suggested that in relationship to curriculum and instructional leadership, "... basic literacy, communication skills, arithmetic skills, and the ability to think, reason and solve problems were necessary outcomes if a school were to be considered effective" (p. 35). These outcomes are directly related to print literacy.

In order to provide appropriate leadership to facilitate an effective school, the principal and/or other educational leaders should have a strong understanding of the curriculum and instruction. An example of this curricular understanding is presented in Becoming a Nation of Readers (1985):

"Instructional leadership in reading entails a considerable amount of specialized knowledge and experience" (p. 112). The importance is apparent that educational leaders possess an excellent understanding of print literacy.

Now that we have entered the Information Age, educational leaders must have an understanding of related curriculum, instruction, cognitive development and associated literacy tools. In the world's industrialized countries, children are no longer becoming thinkers of the Industrial Age, they are becoming the first cognitively aware generation of the Information Age. It is therefore imperative that today's educational leaders have an understanding of how children think, function, and become literate in the Information Age.

PURPOSE OF THIS STUDY

The major use of computers with children has been as drillmaster. Scollon and Scollon (1984) write: "The predominant use of microcomputers for children is in drill and practice routines" (p. 135). However, teachers have

increasingly begun to employ application software, data bases, spread sheets, and word processing programs in classrooms. In many settings, students do not begin "serious" word processing until the third or fourth grade (Georgas, 1984). Georgas reports that Janet Kane, a researcher on the Bank Street project, has stated: 'There's nothing inherent in the word processor that prevents kids from doing it earlier' (p. 133).

There has been relatively little investigation reported as to the use of this new technological tool in the evolution and development of literacy (Collins, 1985; Daiute, 1985; Fisher 1983, Kurth & Stromberg, 1984, Sheingold, Kane, & Endrewelt, 1983). Typical of the comments one reads in various professional journals is the following by Jon Madian (1986),

Word processing used in conjunction with sound principles of instruction is revolutionizing how students learn to read and write. Many of the most influential, humane curriculums, from Dewey through The National Writing Project, Poets-in-the-Schools and language experience movement, can achieve much finer articulation when supported by word processing (p. 17).

However, there is a great deal we do not know about using computers with children. Cromer (1984) writes: "The many educational areas that may benefit from computerized instruction have yet to be scientifically studied" (p. 25).

Not all computer authorities have welcomed the Information Age into classrooms (Weizenbaum, 1983). Among

many questions is one concerning appropriateness of using computers with young children. Joseph Weizenbaum (Brady, 1985) has articulated this concern in a recent interview:

... I don't think that we should use an entire generation of American school children as experimental subjects. Of course, experiments should be carried out to help determine, among other things, what actually can be accomplished with computers and children, but these experiments ought to be small--involving one school here, another there. To use the entire school population of the United States as experimental subjects is at the very least reckless (p. 25).

The vast majority of articles appearing in professional journals are based on opinions, limited observation, and subjective intuition. Little research or investigation has been conducted in the area of young childrens' literacy development and use of a computer as a word processing tool.

Many scholars have called for further research into the use of computers with students (Bruce, 1985; Dalute, 1985; Kurth & Stromberg, 1984; Newman, J., (1984); Sommers, 1985; Weizenbaum, 1983). Bridwell and Duin (1985) have written: "... we don't have sufficient research data to demonstrate that computers are much more for writers than ultra-fancy typewriters and personal printshops" (p. 116). Clark (1985) writes:

The need now is for extended studies to examine precisely what happens when a word processing facility is available." "What happens when words 'dance in light' and you can 'swim through text' to quote two alternative metaphors for the liberating effect of word processing (p. 20).

The following is taken from a recent report (Tech Central, 1986) to the U. S. Secretary of Education (the first report of the Department of Education or of any other national task force to be published electronically before being published in print):

Research and development are needed to understand the cognitive and affective consequences of the new information technologies and to guide their development and application in educational settings (p. 13).

Judith Newman (1984B) has phrased specific questions concerning written language learning and computers:

There are a number of crucial questions we need to ask about software and computer-based language learning activities:
 What role does the computer play in these learning experiences?
 What is the teacher's role?
 To what extent does this software let learners take control of their own learning?
 Does it facilitate a sharing of knowledge? (p. 762)

Spencer and Baskin (1983) have formed some questions about the use of word processing relating them directly to early childhood education:

When is a child old enough to effectively use a word processing program to type letters of the alphabet, numbers, and other symbols? At what point can a word processor aid a child in beginning to write simple sentences, paragraphs, stories, or poems? There are no easy answers to these questions: a child's maturity, capability to identify keys, and the availability of adult assistance in teaching use of the program are all factors in determining when word processing can be successfully introduced (p. 21).

The present study, by providing an initial investigation into children's early literacy development associated with

computers provides an understanding to similar questions. Through the observation of kindergarten children and their use of a word processor, this study provides an understanding as to how and if young students can use this new literacy tool. Reported findings also provide those associated with the field of early childhood education a better understanding of using computers with young students.

In addition, researchers need to consider that our society and culture are rapidly changing as we approach the 21st century. School administrators and others associated with educational administration must consider moving beyond the "status quo" of the past and prepare for the future.

Early in this decade Culbertson (1983) wrote:

Administrators, including those in education, must confront the future if they are to lead. Their leadership role, however, is not that of effective prediction but, rather, that of shaping and of even helping invent the future. Those who lead need a vision of the future, buttressed by understandings of societal change (p. 273).

Research in the field of educational administration can provide guidance to school administrators as our society is drawn more fully into the Information Age. Findings from this investigation will be useful to teachers and researchers as well as educational leaders. Cromer (1984) writes:

"Principals need much more than just a passing knowledge of technology if they are to translate the future into today's schoolrooms" (p. 46).

There are many unanswered questions as education continues to evolve from the Industrial Age into the Information Age. A challenge to educators in general and school administrators in particular is to provide quality opportunities and a relevant education for our blooming youth. Culbertson (1983) writes:

... an important task facing leaders is that of assessing the degree to which schools are currently pursuing objectives that reflect the needs of the declining industrial society and the degree to which they are linked to the needs of an expanding information society (p. 282).

As we continue to evolve into the Information Age, school administrators will find scholarly written theoretical and practical research studies in education and particularly educational administration extremely useful. It is important for researchers to investigate curriculum and instruction tools of the Information Age in order to provide empirical knowledge which can be used for guidance by leaders in education.

This study was conducted in order to provide a component of empirical knowledge to the understanding of curriculum and instruction in the Information Age. Young children today are using tools of the Information Age in their evolution of literacy. It seems apparent that such empirical knowledge of children's use of computers will assist school administrators in their providing leadership for students and staff. Further, from the following literature review to the final

section in Chapter V titled Implications, this study provides insight into the relationship of print literacy and the literacy of technology which can assist school administrators in quality leadership of curriculum and instruction and consequentially student achievement.

The intent of this study has been to observe and analyze young children's behaviors and their products associated with the use of a computer system: computer, monitor, printer, and word processing software.

STUDY STATEMENT

If given the opportunity, how will children use word processing in their print literacy development during their Kindergarten experience?

Questions

1. What developmental sequences related to print literacy reveal themselves as kindergarten children use a word processor?

1a. In what ways are these sequences the same as or different from those identified by researchers studying young children's use of pencil and paper?

1b. What type of time commitments do children make at each stage of these developmental sequences?

2. How do the physical attributes of the computer environment influence children's behavior associated with

word processing? For example: screen color or computer location.

The study statement and associated questions have been derived through preliminary investigations and review of relevant literature associated with this research topic. In order to investigate these questions, this study's research design was qualitative in nature. Such a research approach is often employed when studying a human process (Baghban, 1984, Calkins, 1983; Diesing, 1983; Vygotsky, 1978). In the Preface to Taylor's (1983) book Family Literacy, Dorothy Strickland writes:

The observation and analysis of children's literacy development in natural settings hold exciting promise for the extension of our knowledge of how children become effective readers and writers and of the contextual factors that may support or constrain that development.

Writing about research techniques associated with writing and the new technologies, Halpern and Ligget (1984) state:

Descriptive research should investigate the activities of those who compose in a variety of ways for a variety of reasons. Such research might include ethnographic or naturalistic studies, case studies including protocol analysis, field studies, longitudinal studies, and content analysis of messages (p. 82).

STUDY ORGANIZATION

Following chapter I, Introduction, chapter II, Review of Related Literature, encompasses a review of literature associated with print literacy and the literacy of technology

as it relates to the topic of this investigation. Chapter III, Research Design and Methodology, describes the research methodology and design necessary to conduct this investigation. Chapter IV, Presentation and Analysis of Data, contains tables, figures, and observational data. Chapter V, Summary, Findings, and Conclusions, summarizes and concludes this study of young children's literacy evolution associated with a word processor of the Information Age. Finally, a Bibliography and Appendices follow chapter five.

The end of the Twentieth Century is a thrilling time for our culture. We are experiencing the beginning of the Information Age. A current rediscovery in American education is the writing process and its acceptance as an integral component to literacy. There is much to be learned.

Bridwell and Duin (1985) write:

One of the most exciting things about our work is that so little is known--either about how we humans have produced written language for centuries or about how computers may help us with this uniquely human enterprise in the future (p. 121).

CHAPTER II

REVIEW OF RELATED LITERATURE

INTRODUCTION

This chapter reviews literature related to the evolution of literacy, associated technologies, the development of writing in young children, and research involving four to seven year olds and their use of a word processor. There are five major sections contained in this chapter. The first section is devoted to an overview of the prehistory and history of writing and literacy. This is followed by a section focusing on the development of language and cognition. Literacy is the topic of section three. The following section about writing reviews recent research concerning young children's writing development. Computers and their use by young children for writing is the topic of the final major section in Chapter II.

PREHISTORICAL AND HISTORICAL PERSPECTIVES ON LITERACY

Oral Communication

Linguists and others explain that primitive societies have long practiced oral language traditions (Burrows, 1984; Morell, 1985; Stubbs, 1980; Vygotsky, 1978). These

traditions assisted our ancestors in passing on their culture from one generation to another (Holdaway, 1979). An important component of these traditions, story telling has long been an art and skill praised and esteemed within cultures. Many people in primitive societies exhibit amazingly longterm memories as they tell stories of their people, history and culture (Stubbs, 1980). The techniques they use in order to remember such long stories are rhythm and rhyme. Holdaway (1979) writes: "Chant, song, dance and linguistic rituals are among the most powerful forms of human learnings, primitively satisfying, deeply memorable, and globally meaningful" (p. 58).

Stories of prominent cultural tradition are told and retold to others in rhyme with rhythm. Such a patterned approach assists other members of the society in learning and remembering stories and traditions. This approach of transferring cultural information from one generation to another has continued as we learn rhythmic songs and rhymes from our parents and share them with our children (Frobel, 1891). Our own language's traditional rhymes, found in Mother Goose, were used to pass on cultural traditions through oral communication. It is suggested that some of these traditional "...rhymes may be relics of formulas used by the druids in choosing human sacrifices" (Baring-Gould, 1967, p. 12). Today, our children continue this tradition of

oral enculturation through their learning and reciting of rhymes, finger plays and songs.

Oral communication also incorporates many gestures, facial as well as body, plus nuances of voice, rhythm, and volume which print can not duplicate or express. Edward Hall (1959) has written: "In addition to what we say with our verbal language we are constantly communicating our real feelings in our silent language--the language of behavior" (p. 15).

The various additional components which we add to our oral language communication are aspects of our own individual cultures. In addition to transferring oral literature and cultural traditions from one generation to another, we continue the same with oral language gestures and supportive communication skills. This enculturation transcends both oral and written language (Hall, 1959).

Chronological Development of Literacy Tools

Anthropologists and others have debated the significance of prehistoric cave art, artifacts and their attendant markings since their discoveries by modern men and women. Though the debate continues, the point is settled that they exist and that they communicate to the casual observer a pictorial representation of the existence of certain animals and perhaps other items which existed during the life time of the artists and recorders. Among the artifacts are certain

drawings containing various marks, some similar to chevrons, which may represent an attempt at symbolic communication (Marshack, 1975).

A long time ago, someone discovered that when clay was marked and allowed to dry, the mark remained. This became a major step for the human species once there was the realization that clay in combination with a stick could be useful in producing designs. Later, this concept would be adapted to the invention and production of clay tablets. This invention, combined with the desire to retain administrative records, evolved into our ancestor's early writing about 6,000 years ago in Mesopotamia.

The papyrus reed had been a major building material in Egyptian culture for many years. Egyptians had been using it in various technologies, housing construction, cooking and sailing. Eventually, it was discovered that if papyrus reeds were split, layered in cross directions, wrapped in cloth and then pounded together that a paper-type substance was produced. In place of a stick, the Egyptians found that a hollow reed with sharpened point worked better as a writing implement.

For thousands of years the versatile papyrus reed was used extensively in the development of print literacy. Not only were papyrus reeds used to write on, they were also used as the writing implement. The form which early print literacy took was that of scrolls. As a result of processing

papyrus into a medium to write on, long rolls, scrolls became the end product. In order to read a text, an individual had to unroll one end of the scroll while rolling up the other. Papyrus scrolls tended to be somewhat brittle and thus required careful handling. Such technology was not useful for quick referencing or heavy use.

Due to political rivalry, parchment was invented around 170 B.C. in Asia Minor. An Egyptian King, Ptolemy VI, cut off the supply of papyrus to his rival King Eumenes II of Pergamum in Asia Minor. By this time in human history written records were becoming a necessity; therefore, a substitute had to be found. The invention of parchment became the answer and an improvement over the papyrus scroll. Animal skins were specially treated and prepared as a writing surface. Scribes could write on both the front and the back of parchment. Parchment was produced in separate sheets. It was soon discovered that a number of parchment pieces could be sewn together forming what the Greeks termed "volume," a book. Access to reference material became easier.

China was the birth place of paper as we know it. Using mulberry, waste fish nets and rags, Ts'ai Lun developed a process for making paper in A.D. 105 (Boorstin, 1983). Paper and the knowledge of making paper slowly drifted to the West, eventually reaching Europe when it was brought to Spain by the Moors during the 14th century.

While camel and rat hair brushes were used in China and the East, reed pens were the implements of choice in the West until about 500 A.D. and the invention of the quill pen. Although paper had been invented in China by this time, the quill pen, invented in Europe, was first used on parchment. The innovation of using sharpened tail feathers from geese and swans, thus inventing the quill pen, was a marked improvement over the use of reed pens as writing implements.

Another writing implement used during this same time period was the pencil. For about a thousand years, pencils had been used in both the eastern and western hemispheres. The modern pencil consisting of a wooden shaft incasing a graphic-clay core did not evolve until the end of the 18th century. Prior to this, pencils were simply pieces of graphite wrapped in cloth.

Our ancestors used printing for a variety of everyday purposes before using it in connection with religion and knowledge. Printed textiles have been discovered in ancient China and Egypt. The initial development and use of printing on paper occurred in China. Here the technology was used extensively for religious purposes. Buddhist monks pioneered much of the early printing technology. Early printing consisted of carved wooden blocks usually with a religious motif or an ideograph from their print language. The general print technology developed by the Chinese gradually moved westward. Playing cards, printed before books, appears to be

the vehicle supporting the spread of printing technology into and through Europe (Boorstin, 1983).

After the invention of literacy, probably the most important literate artifact to be produced to date was the Gutenberg Bible. In reference to the change initiated by Gutenberg, Boorstin (1983) writes:

He was a prophet of newer worlds where machines would do the work of scribes, where the printing press would displace the scriptorium, and knowledge would be diffused to countless unseen communities. (p. 510)

Prior to printing innovations masterminded by Gutenberg, printers found it difficult printing text with the carved wood block technology of the early printing era. Gutenberg solved these technological problems with the invention and subsequent development of moveable type and the printing press. He invented a system for producing large numbers of type faces, individual letter pieces of the same relative size. With large quantities of type pieces available, printers could easily arrange them in special forms for printing. Once the type was invented, the manner of holding them in place and the development of a press followed.

The technology of printing developed by Gutenberg did not radically change for the next three hundred years, until the Industrial Revolution. The quality of paper and printing began to improve during the 19th century. In similar fashion, pens did not change radically until the Industrial Revolution and the invention of the steel tip. Although

there is evidence from Pompell of bronze-tip pens dated about 1,000 B.C., they apparently did not become a standard writing implement. Invention of the steel-tip pen in 1780 paved the way for mass production of related writing implements. Fountain pens were developed and improved during the 19th century. Later in that century, the ball point pen was patented. Modern paper techniques were developed during the later part of the 1800's. Today's colorful felt tip pens were introduced to the western consumer market by the Japanese in 1964.

The manual typewriter was invented soon after the American Civil War. In 1908, the first electric typewriter was patented in the United States. Following various letter key arrangements, the QWERTY keyboard, designed by C. L. Sholes in 1872, became the standard. The QWERTY keyboard was designed to slow typists down and reduce the jamming of keys. During the 1930's, August Dvorak designed his own system concentrating primarily on increasing efficiency and reducing errors. Although the Dvorak keyboard has received renewed interest in recent years, the QWERTY keyboard remains the industry standard.

The latest literacy tool to be developed by the human species is the computer. During the last quarter of the 20th century we are witnessing an explosion of Information Age technology. The capacity of the '40 and '50's mainframe computers is found in today's microcomputers. An early use

of large mainframe computers was text analysis. They also provided early designs for networking of terminals and printers for word processing. With the growth of microcomputers in numbers and power during the late 1970's and early 1980's, word processing programs have become more sophisticated and universally employed. During the later 1980's microcomputers programmed with word processing are a major component of telecommunications and almost instant access to the world.

Relationship of Literacy to its Tools

Many thousands of years ago our early ancestor's hunting and gathering societies evolved the capacity to recognize quantity. Following the hunt or gathering of food stuffs, harvested supplies were distributed among group members. As these groups grew in number and individuals became more specialized in their roles, it became more important to understand quantity for distribution of food, weapons, utensils, and other resources. Eventually, many hunting and gathering groups evolved an agricultural component to their society. The ability to define allotments and distribute shares fairly became ever more important with the cultural evolution of societies.

Six thousand years or more ago, society had evolved to the point where human memory could no longer be the sole means of keeping track of commerce and economies. A form of

permanent record keeping had to be developed. Necessity became the mother of invention. Someone in Mesopotamia realized that when wet clay was marked and allowed to dry, permanent marks remained. Through a necessity, readily available appropriate materials and someone developing a set of symbols, our ancestors invented writing. The early evolution of written language was a combining and intertwining of tool and concept which has continued through to the present.

Our ancestor's early records were accounts and lists used to register economic and administrative activities (Boorstin, 1983; Kust 1981). Oxenham (1980) writes: "In sum, the combined pressures of commerce, technology, government, politics, religion and culture have created needs, rewards and demands for literacy." From this beginning, the new concept of literacy and related technology continued to evolve. Those who became literate in written language and related tools discovered new concepts and invented new uses. Now that there was a medium for maintaining permanent records, literate individuals realized that these records could be stored for future use and sent to others far away. If sending records long distances, why not include a message? As the use of literacy became more sophisticated and generalized to a society, changes in related tools took place.

The next major change in literacy tool technology occurred in Egypt with the development and use of the papyrus reed. The resulting scroll produced from papyrus was much easier to transport short or long distances. Storage also became easier. Egyptians and others could get more information on a scroll than they could on clay. Also, scrolls didn't break when dropped. However, the papyrus scroll did have its draw backs. Papyrus was brittle and could easily be damaged if handled a great deal. Since print literacy was in scroll form, it was not easy to access references.

Associated with the evolution of written language is the concept of written historical records. It became possible to record events in a print form to be saved forever. With time, this aspect of literacy replaced the need for extensive memories and the tradition of oral story telling. From the author's perspective, print literacy provided a view of what had transpired. Stubbs (1980) writes:

The basic function of a written language, on which other functions logically depend, is what we could call the recording or storage function, and hence the transmission function. Writing provides a way of recording language which is at once accurate, permanent to all intents and purposes with no limitation on time, and transportable, with no limit on distance. (p. 102)

As our ancestors developed parchment, changes continued to follow in the use and expansion of print literacy. Individual sheets of parchment were created and it was

eventually discovered that these could be sewn together creating a book. Whereas a scroll allowed writing on one surface, it was discovered that parchment could be written on the front and back. In addition, it was found that leafing through a book for a reference was much easier and generally quicker than with a scroll. Though the writing material changed, supporting new ways of thinking, the writing implement stayed the same. Reed pens continued to be the common writing tool.

When the quill pen was originally developed in Europe during the sixth century, it was used on parchment. Paper, for writing, would not be available in Europe for another eight hundred years. Those using a quill found that they could write for longer periods of time since this pen held more ink. Writers also found it necessary to use a small knife in order to sharpen their quill pen points from time to time. Hence the development of the "pen knife." Though the quill pen has not been a common writing implement for almost two hundred years, a small pocket knife is still commonly referred to as a "pen knife."

As pen technology has grown so has the number and ease of their distribution. When the fountain pen was invented it offered writers greater production capabilities. No longer did a writer have to continually dip the pen in an ink well. The steel point made the "pen knife" obsolete. Pens now lasted longer, and as an aspect to the Industrial Revolution,

companies developed mass production techniques that were able to satisfy an ever expanding market demand. Today, ball point and felt tip pens have almost eliminated the threat of running out of ink. Whereas in the past the reed, quill and fountain pens had the capacity to be refilled, most of today's writing implements do not have such a characteristic. These latest editions of pen evolution are components of the throw-away society and therefore are disposed of after use.

Along with the rapid development of pen technology during the Industrial Revolution, paper production increased dramatically as a result of innovative techniques and related machines. A variety of papers became common and available to a widening literate population. Prior to the innovation and expansion of paper production, paper was considered an expensive commodity. Individual pieces of paper were used over and over again. Once the production of paper became mechanized and paper became inexpensive, it was used extensively in schools, offices, packaging and throughout Western cultures. Paper has reached the same level of evolutionary development as that of pen technology. We presently live in the print litter era, throwing away both written language documents, junk mail, and implements for creating them, pens, pencils, and printer ribbons.

However, earlier in the evolution of written language, the use of paper in Europe allowed for the invention and refinement of printing. Once Gutenberg perfected the

technology of printing, a new profession evolved. This new profession went beyond the realm of simply printing text. Eisenstein (1985) writes: "... new functions performed by early printers, not just as businessmen but also as editors, translators, lexicographers, and cultural impresarios." Print shops became common sights in towns and cities of all sizes. During these centuries following Gutenberg and before the Industrial Revolution, printing was thought of as an art form. This was no doubt an outgrowth of scribes using pens and their writing of manuscripts. Printers took pride in their artistic accomplishments with type and press.

As print technology spread throughout the West, no longer was Latin the only print literacy language. Vernacular languages began to be accepted. Whereas Latin had been the universal language of intellectuals and used for formal education, eventually provincial languages became accepted by the illiterate and educated of society. Dating from Roman times, manuscripts were usually copied and or written in Latin. Beginning in the second half of the 15th century, printers began to use the vernacular of the area in which they lived.

Other changes slowly came about as people began to work with the technology of printing. It took more than a hundred years after Gutenberg before pagination became standard. Even then, numbering was often incorrect. The technology of printing has continued to evolve to the present where books

commonly include a title page, table of contents, numbered pages and an index (Boorstin, 1983). These various innovations helped to make referencing much easier. Individuals can now find quotes, compare them from book to book, or use them in other ways. As Plato recounts Socrates dialogue with Phaedrus 2,000 years before Gutenberg, Socrates warns of the loss of memory due to the new technology of writing. Now with the profusion of books and easier referencing, people no longer have to remember large amounts of information.

Manuscript books had provided access to only a few people and couldn't provide a universal print form. Actual handwriting of scribes and authors varied and the use of letter forms often varied from region to region. Though various print fonts have been developed during the past 500 years, today in our various written languages there appears to be a basic shape to each individual letter across these fonts. Today's standard letter shapes allow illiterate individuals easy access to knowledge through reading.

Once typewriters became standardized with their keyboard and fonts, this writing implement allowed individual's to more easily communicate without concern for correct handwriting. As with the printing press, this tool provided a universal print form. In addition, for the individual writer or copier of others' work, the typewriter allowed people to write faster and produce more than any earlier

individually-controlled technology. Similar to the print letter standardization, typewriter products also allow easy readability.

The latest tool of the print literacy evolution, computers, appears to be a combining of many earlier technologies. The QWERTY keyboard standard of the typewriter is presently the norm for computers. The basic letter form as I now write with a word processor and look at the microcomputer screen looks the same as if I were reading a book or typing with a typewriter. The hard copy standard letter shape of this or other electronic text, once tractor paper is removed and accordian paper is separated into individual pages, appears the same as printed or typed text.

Each new change in literacy tool evolution incorporates a new inherently related cognition. Although there is a new intrinsic cognition with each advance in literacy tool evolution, as societies begin to incorporate the new technology they attempt to use it from the perspective of their previous literacy tools. Initially, printers following the technological inventions of Gutenberg, printed large books similar in size to manuscript books produced in scriptoriums. With time, printers were able to print books in small paper back editions which fit into one's pocket. It took hundreds of years for this concept to evolve and then societies to accept it both physically and cognitively. Similar cognitive processing continues with tools of the

Information Age. There are many new literacy considerations in the present world of microcomputers. No longer are erasers or white out necessary for correcting text. This technology allows one to easily move text about within one text file or to new or old files. No longer does a writer leave a text space, spaces are now an act of textual input. It's easy to replace, copy and delete text to name just a few literacy functions which are different with this new technology. In addition, the concept of reference is changing. It is easier to find specific words, phrases, or thoughts within an electronic text than in a printed book which itself was an improvement over a manuscript book which was an improvement over a scroll.

Since prehistory, the production of print literacy has been a private act. Although historically, reading has been a public act at time, (e.g. oral reading in local taverns) writing has generally been a private act. In many cultures there exists a certain social inhibition of not looking over someone's shoulder at what is being written. Generally, compositions become public once they are printed or posted. Even when made public, the reading component of print literacy is private unless a reader intentionally shares the print orally with others. Now, with the proliferation and universality of televisions and video monitors throughout western culture, when writers use a microcomputer their work becomes public. Looking at video screens has become a

natural component of our culture whether in a local arcade, boutique, school or home. People have become so familiar with looking at video screens that they will naturally look and often respond to what they see.

It is evident that literacy has changed with new forms of literacy technology. Prior to the invention of paper, scribes were few, and clay tablets and papyrus scrolls were not easily transported. During the Nineteenth Century pencils and pens were refined, and became more widely distributed and useful writing implements. The typewriter continued to expand our abilities to produce literate communication in a written format. Today there are many who feel that the invention of computers and their use in communication technologies may have an impact upon our society similar to that which the printing press had on the world of our ancestors 500 years ago (Evans, 1979; Gallagher, 1985; Papert, 1980; Toffler, 1980).

LANGUAGE AND COGNITIVE DEVELOPMENT

Communication, whether oral or written, is a function of an individual's cognitive processes. Debate and discussion have occurred through the years relative to the relationship of language and cognition. This section provides a glimpse at some of the important considerations concerning language and cognitive development as they relate to literacy.

We have for years acknowledged that a child's language evolution is a natural aspect of human growth and development. Unless a child has some biological or psychological defect, it can be assumed that language will be acquired. Speech and language acquisition in children is a natural process (Allen, 1976; Baghban, 1984; Stern in Vygotsky, 1962; Vygotsky, 1978). It is a function of their cognitive processes related to interactions with their environment. Children follow a general path in their acquisition of language (Ferreiro, 1982; Gesell et al., 1940).

An aspect of the interrelationship of language and cognition is the nature vs. nurture debate which has continued for years (Vygotsky, 1962). This debate specifically questions whether cognitive and language development are biologically determined, due to genetics, or influenced sociologically, a result of the environment in which one matures. Howard Gardner (in Plattelli-Palmarini, 1980) writes:

At issue ... whether human linguistic capacities can in any interesting sense be considered a product of generally 'constructed' intellectual development (as Piaget contended), or whether they are a highly specialized part of human genetic inheritance, largely separate from other human faculties and more plausibly viewed as a kind of innate knowledge that has only to unfold (as Chomsky insisted). (p. XXVII)

I approach this study from the perspective that both biological and sociological elements are aspects of normal linguistic and intellectual growth and development.

There are numerous rules and conventions to any language and particularly the English language (Burling, 1976; Stubbs, 1980). In addition to being unaware of these rules and conventions, young children also are not aware of individual speech parts, i.e., sentences, words, and letters (Stubbs, 1980). Children, cognitively functioning in the pre-operational stage of development, approximately 3 - 5 years old, are unable to visualize parts and the whole simultaneously (Huber, 1985). Even children who enter school at age five often are not aware of the individual components to their speech (Donaldson, 1978). Children, alone as well as when interacting with others, put forth an intense effort attempting to reinvent, generate, and discover language rules and conventions. (Inhelder in Piattelli-Palmarini, 1980). In addition to psychological processes, children's language development is partially a social phenomenon.

Language development in young children is promoted through play and active involvement in social institutions and situations. It is important for the intellectual development of children that they interact with their surrounding environments. Through such interaction, children psychologically develop an understanding of specific objects and concepts. During their childhood, children

psychologically follow a process of actively transitioning from one cognitive stage to another. The young child has opportunities to play with and manipulate items within his/her environment during his/her sensorimotor stage (Franklin, 1973). During the preoperational stage, the normal young child begins to realize the abstractness of his/her toys. A child two or older accepts that a toy out of sight can still exist. In just a few years, the child psychologically evolving through the concrete operations stage of cognitive abilities will be able to use abstract symbols to represent an object or concept. An example of a child's growth from concrete experiences to abstract representation can be observed when a child draws a picture of a cat. The picture consists of a few squiggly round lines, a couple of straight lines depicting whiskers and two accompanying circles with dots. This young artist may then verbally label the "cat picture."

It is important psychologically to have an understanding of concepts and objects in order to learn a language (Tolstoy in Vygotsky, 1962). Fodor (Piattelli-Palmarini, 1980) has stated: "Clearly, you can't learn a word that expresses a concept that you don't have" (p. 173). Fodor follows in summary: "Nobody would learn the word 'cat' unless he knows what a cat is" (p. 173).

This understanding of "cat-ness" or "word-ness" leads us to Piaget's consideration of language being "... a particular

case of semiotic function" (Piattelli-Palmarini, 1980, p. 163). It follows that words in a language, oral or written, are signs that represent different objects, concepts, and ideas. In addition, certain signs have multiple meanings and are dependent upon the context in which they are used. In summary, the language and cognition relationship can be viewed as the socio-psycholinguistic process. The individual interacts socially with his/her environment and psychologically (cognitively) generates language to function within the social environment. Harste, Woodward, and Burke (1984) explain: "By process we mean the cognitive stances language users assume, and the strategies or cognitive activities language users engage in, during a literacy event. We label this process "socio-psycholinguistic" because we see language as sociologically rooted, and language learning as understandable only when viewed within its social context. Psycholinguistic processes have their genesis in the literacy demonstrations made available to language learners as they encounter members of their interpretive community engaged in the psychological and sociological actions associated with literacy" (p. 49)

Piaget observed that children actively reinvent through discovery (Donaldson, 1978). Children cognitively attempt to understand their world through invention of hypothesis and associative implementation (Ferreiro, 1982; Kamil, 1985; Wellman, 1982). Such hypothesis-inventing requires the

understanding of objects, concepts, and ideas, often along with the corresponding words, in order to place these into some cognitive form, schemas. Through their discoveries and language play, children assimilate their new inventions into schemas and cognitive understanding (Ferreiro, 1984).

Ferreiro and Taborsky (1982) write:

Evidence ... suggests that language learning does not proceed through the acquisition of isolated elements which gradually join together, but rather through the formation of systems where the value of the parts continually redefines itself in function with the changes in the whole system. In addition, this evidence also demonstrates the existence of what we could call 'constructive errors,' that is, responses differing from correct responses but, far from impeding emergence of the latter, permitting subsequent development. (p. 8-9)

The process of language development that children experience occurs in the natural surroundings of their family and community (Leichter, 1984; Schachter, 1982; Smith, 1984). Healthy young children hear and experience those around them converse, chat, and sing, often while enjoying cuddles and coos from loving parents. In natural settings, parents interpret, reiterate, and model speech and oral language. Children listen, speak, actively interpret, hypothesize, and reinvent language as they attempt to be an active member in their social environment. Through this process their own linguistic abilities evolve and develop (Donaldson, 1978; Holdaway, 1979, 1984). The priority in language development is not immediate correct pronunciation and usage, but the continual generating and refining of one's vernacular

language (Ferreiro, 1982; Holdaway, 1979, 1984). Young children have the opportunity to interact with their parents and others in activities associated with this process which often promotes additional contact, environmental awareness, and further affection (Vygotsky, 1962; Holdaway, 1979, 1984). Harste, et al. (1984) write:

Language convention, like language, is socially invented in a supportive environment which makes such discoveries available; it is not an heirloom like a grandfather's clock which is passed along from generation to generation, but rather, more like a civilization whose heritage is passed along by those immersed in it. (p. 30)

Language-learning skills are not isolated from mental growth (Donaldson, 1978). Vygotsky (1962) states: "The child's intellectual growth is contingent on his mastering the social means of thought, that is, language" (p. 51). Children require a variety of experiences in order to develop concepts which they then can assign a learned language symbol to represent. Even though thought and language are different, the interrelatedness of language and cognition are extensive (Vygotsky, 1962). Chomsky (Piattelli-Palmarini, 1980) states:

I take it for granted that thinking is a domain that is quite different from language, even though language is used for the expression of thought, and for a good deal of thinking we really need the mediation of language. (p. 173)

The issue of intelligence in relationship to socio-psycholinguistics gained further clarification in the late 1970's during the Piagetian Constructivism and Chomskian

Innatism debate. Piaget stated: "In other words, and here I totally agree with Chomsky, language is a product of intelligence rather than intelligence being a product of language" (Piattelli-Palmarini, 1980, p. 167). These scholars attempt to make it clearly understood that language produced through the socio-psycholinguistic process is a product of one's intelligence.

Related to language and intelligence, some scholars feel that cognitive development may be greatly enhanced by becoming literate (Olson, 1985; Stubbs, 1980; Vygotsky, 1962). Oxenham (1980) writes: "It is not implausible to suppose then that the association between literacy and intellectual and scientific advance is close" (p. 60). Barbara Inhelder (Piattelli-Palmarini, 1980) has written:

The more we progress in our knowledge of the language development of the child, the more we become aware of the intense activity he puts forth to discover the rules and functions of his own linguistic capacity. It is legitimate to think that this activity of linguistic discovery, in its turn, has a repercussion on the development of his knowledge in other domains. (p. 134)

Further consideration on this concept comes from Chomsky (Piattelli-Palmarini, 1980) as he writes:

..., it is entirely conceivable that some complex structures just aren't developed by a large number of people, perhaps because the degree of stimulation in their external environment isn't sufficient for them to develop. (p. 176)

There are scholars who question whether many individuals reached the cognitive stage of formal operations prior to the

advent of earlier technologies (Huber, 1985; Stubbs, 1980). Historically, we are aware of the lack of literacy among the majority of our ancestors prior to the invention of the printing press and wide distribution of printed material. The issue of universal literacy is only 3 or 4 generations old (Oxenham, 1980). There are those who theorize that with the advent of new technologies, cognition and literacy is enhanced (Holdaway, 1984; Stubbs, 1980). Related to this, Dalute (1985) writes:

Although it is useful to consider writing in the mind separately from writing with the hand to understand the dimensions and complexity of each activity, the writing instrument itself can affect the cognitive process. The instrument can stifle the mental dynamism of writing, enhance it, or make no difference at all. (p. 66)

Seymour Papert (1980) of MIT shares his thoughts about the creation of a completely new learning environment based on the latest tools of the Information Age in his book

Mindstorms:

I believe that certain uses of very powerful computational technology and computational ideas can provide children with new possibilities for learning, thinking, and growing emotionally as well as cognitively. (p. 17)

Further, Papert feels that children will begin thinking about thinking, learning about learning and become epistemologists (Papert, 1980, c. 7). We may be experiencing the beginning of another great leap in human language and cognition.

Scollon and Scollon (1985) write:

Our preliminary work with computer conferencing has led us to think that the current rapidly expanding use of computers in communication is bringing about change in the possibilities of discourse, possibilities not seen in the world at least since the introduction of widespread printing. (p. 135)

Developmental psychologists, linguists, and others acknowledge that language is a natural component to human growth and development which evolves through a socio-psycholinguistic process. Children develop an awareness of language through its use. As children grow, their oral and written language evolves through their discovery, hypothesizing, and generating. No matter where one is in the nature vs. nurture debate, there appears to be agreement about an interrelationship to language and cognition. There also appears to be an accepted theory as McLuhan (1962) in "The Gutenberg Galaxy" writes that the socio-psycholinguistic process of human language evolution is influenced by communication technologies.

LITERACY

Related to language is literacy which in a print literate society is a natural process and component of human growth and development. Smith (1984) has written, "All children are born illiterate" (p. 143). Literacy is a composite of skills which we continue to develop throughout our lives. This section delves into recent research and

writings about literacy. I begin with some thoughts concerning a world perception of literacy.

Many people throughout the English speaking world have theorized for years that reading is synonymous with literacy. In American as well as British schools, reading has, and generally continues to be, the important academic subject. Due to global British colonialization and American influence, this notion has been transmitted to societies throughout the world. When national and international governments and organizations refer to literacy rates, they express numbers signifying the percentage of people who have developed some level of reading skill. Throughout the world, there appear to be two standards of literacy. Stubbs (1980) writes: "... one referring to the ability to read and write, one referring to wideness of education, and both these uses are relative to cultural expectations" (p. 14).

Literacy is a relative term, and the expression "cultural expectations" allows for yet another division: literacy and functional literacy. Functional literacy allows an individual to get along on a daily basis within his/her environment. However, such limited literary skills are not used for learning or entertainment. Functional literacy skills exhibited by an individual would consist of the ability to read billboards, signs, simple notes, and write his/her signature. Beyond this simple ability to function in one's immediate environment, is literacy: the ability to use

these skills for intellectual stimulation and entertainment, e.g. reading, writing, theatre, study, etc. (Stubbs, 1980).

Literacy has more components and is a much more encompassing concept than simply reading. First one should consider it as a process and not a magical moment in which suddenly one becomes literate (Ferreiro & Teberosky, 1982; Goodman, 1984; Harste, et al., 1984). As Vygotsky (1978) writes of learning about signs, "They are not invented or discovered by the child in the form of a sudden insight or lightning-quick guess (the so-called 'aha' reaction)" (p. 45). Secondly, in more recent research, literacy has been observed to encompass not only the skills of reading and writing, but also those of speaking and listening (Baghban, 1984; Bissex, 1980; Holdaway, 1984; Taylor, 1983). All of these skills are interrelated in the process of becoming literate (Holdaway, 1979, 1984; Stubbs, 1980; Vygotsky, 1962). These two aspects of literacy are summarized by this quote from Harste, et al. (1984):

Literacy is never a glorified state one enters, but involves constant orchestration and reorchestration of the sign complexes of literacy as contexts change and evolve. (p. 185)

Researchers in various disciplines have published findings that literacy begins long before children begin school (Allen, 1976; Baghban, 1984; Bissex, 1980; Goodman, 1984; Harste, et al. (1984); Holdaway, 1979, 1984; Sheridan, 1986; Taylor, 1982, 1983; Vygotsky, 1962). The development

of literacy begins prior to birth as a fetus listens for sounds from their environment. This early development continues through the foundation years with the result that children have a good understanding of spoken language by the time they enter school (Calkins, 1985; Clark, 1984; Goodman, 1984; Hayes & Plaskon, 1982; Stubbs, 1980).

Young children's knowledge of language is not limited to their ability to ask for assistance and make needs known and understood. It also encompasses a large vocabulary and the ability to be articulate about their lives and experiences. In addition, many children enter school with an understanding of symbol relationships (Goodman, 1984). They are aware that the Golden Arches means a place to eat and that the large, M-shaped sign has the connotation of McDonald's, hamburgers and French fries (Baghban, 1984).

The use and development of literacy is an extremely important component to family life (Anderson & Stokes, 1984; Butler 1975, Clark, 1984; Heath & Thomas, 1984; Leichter, 1984; Taylor 1982, 1983; Teale, 1984). The ingredients to this component of family life are not broken down into analytical steps which children learn under the supervision and instruction of mother, dad, and siblings. The approach to literacy in a family is that of whole language. All components to literacy, talking, listening, writing and reading, are integrated, generated, modeled and shared by family members. Taylor (1983) refers to this developmental

process in family settings: "It was a whole language process in which listening, talking, reading, and writing grew as interrelated forms of a communicative system" (p. 76).

We have assumed that print literacy is to be learned through formal instruction (Baghban, 1984; DeFord & Harste, 1982; Taylor, 1983). Children spend the first four or five years of their lives in a supportive, accepting and loving environment of the home and greater community where they learn through play, imitation, trial-and-error and by what Piaget coined, "reinvention through discovery." This is too often followed by over-crowded and impersonal experiences at school. Typically, as children begin school, there is a sudden attitude shift: print literacy development can only occur through direct instruction by an adult (Baghban, 1984; Holdaway, 1984; Smith, 1984). Leslie Hart (1986) has written: "If we observe children, we see that they learn magnificently and with joy--until they go to school and encounter aggressive teaching" (p. 48). Also, an attitude change often occurs within families as children begin school. Denny Taylor (1983) reports:

... the data also indicate that 'shifts' occurred in the parents' approaches to the transmission of literacy styles and values, and these shifts coincided with the child's beginning to learn to read and write in school. (p. 20)

Yet the earlier literacy skills of oral language, listening, and early symbol identification have occurred in a relaxed, supportive, and loving home environment. Lucy McCormick

Calkins (1985) makes reference to the type of setting where print literacy can flourish:

Most language--learning occurs through self-generated, functional, holistic activities; through approximation and error; through bonded relationships with people who are joyfully literate. (p. 235)

No doubt, educational philosophies are often a reflection of our human history and a result of social and political considerations of the time. McLuhan (1962) writes:

... from the invention of the alphabet there has been a continuous drive in the Western world toward the separation of the senses, of functions, of operations, of states emotional and political, as well as of tasks--a fragmentation ... (p. 42)

In contrast to Hart's statement, quoted in the previous paragraph, many early childhood educators have always fostered a school atmosphere supporting a holistic approach to the development of literacy. Now, during the eighth decade of the 20th century, similar holistic educational atmospheres are becoming more common in American elementary schools.

Scholars in education and psychology recognize that play is children's work. We realize and accept that children learn through the games and activities they use in their play (Jacob, 1984; Morell 1985). Vygotsky asserts that children will often play beyond their chronological ability (Vygotsky 1978). In Becoming a Nation of Readers (1985), it has been reported that children read at a higher level when reading about a subject which is of interest to them. Children in

these situations are internally motivated and willing to take risks. They are often self-corrective along with their risk taking, and, as a result, accelerate their own learning (Holdaway 1984). Further, Harste et al. (1984), focuses upon the importance of risk in language learning:

Because language is an open sign system, risk is necessarily a central feature of the process involved in its use. Without risk there can be no discovery of the generative potentials of literacy. (p.132)

Literacy is a developmental growth process which continues to evolve throughout our entire lives (Baghban, 1984; DeFord & Harste, 1982; Smith, 1984). Holdaway (1979) writes:

Developmental learning is highly individual and non-competitive; it is short on teaching and long on learning: it is self-regulated rather than adult-regulated: it goes hand in hand with the fulfillment of real life purposes: it emulates the behaviour of people who model the skill in natural use. (p. 14)

As previously mentioned, there are four major components to literacy: speaking, listening, writing and reading (Holdaway, 1979; Stubbs, 1980). These components are integrated and interrelated within our cultural environment. In natural settings, the development of literacy is viewed as a process and achieved in a holistic fashion.

In recent decades, there has been a change in the manner scholars view literacy. The ability to use oral and written communication is a holistic function of cognition and growth through the interactions one has with the social institutions

of society, the socio-psycholinguistic process. Many of the growth functions acknowledged in language and cognitive development are found in the evolution of literacy--an individual's accommodation and assimilation into schema and the influence of family and community. Smith (1984) has written:

... literacy is both individual and social--individual because the impetus must come from the child, but social because literate others must provide the demonstrations that engage the child as a literate member of society. Children do not become literate in a vacuum. On the other hand, children cannot anticipate society's uses for literacy (and perhaps would not become literate if they could). Literacy develops because the child sees what reading and writing can do, and because it is relevant to the child's own creative and constructive purposes (p. 151).

WRITING RESEARCH

There are a number of components and various elements involved in the evolution and development of literacy. One of the most neglected components to be researched is writing. Burrows, Jackson, and Saunders (1984) have written: "Compared to the amount of research in children's reading, the history of research in children's writing is a very scanty account" (p. 174). Considering writing research related to past cultures, Michael Stubbs (1980) has written:

... the forms and functions of written language have been neglected by both linguistics and by sociology and anthropology, and that often only rudimentary, common-sense observations are available (p. 16).

A perspective on recent research is shared by Graves (1984) who wrote near the beginning of the 1980's:

Only 156 studies of writing in the elementary grades, or an average of six annually, have been done in the United States in the last twenty-five years. ... These figures came at a time in American education when most school money was spent on developing children's reading skills. For every \$3000 spent on children's ability to receive information \$1.00 was spent on their power to send it in writing. (p.93)

This section focuses on aspects of writing research which appear important to the early development of print literacy.

We have made an adult assumption through the years that reading precedes writing (Holdaway, 1984; Oxenham, 1980). Related to this assumption, in a print-literate world, functional literacy refers primarily to reading ability while writing has evolved as a secondary skill. Until the past fifteen years, there has been little writing research in the grade school classroom (Calkins, 1985, 1986; Clay, 1975; Graves, 1983). Calkins (1985) writes: "Over the past fifteen years there have been, for the first time, major studies on how children change as writers" (p. 26).

Research focused on children's writing has primarily been conducted by two academic disciplines, psychology and education. Scholars in psychology have conducted research in attempts to discover connections between writing and cognition. Educators have sought additional insight into the teaching of writing. In the early part of this century, Vygotsky (1962) and his associates found that there was

little writing going on in schools. This deficiency in writing has generally continued through the rest of this century, at least to the 1980's. Lack of opportunity to write in schools is no doubt a factor in the small amount of research that has been conducted in this field of study.

Early during the 20th century, many psychologists studied oral language and its complex relationship with cognition. In addition to such studies, Luria and Vygotsky and his colleagues investigated written language. Vygotsky (1962, 1978) and his colleagues found that written speech differs from oral speech both in structure and mode of functioning. They also determined that even a minimal ability of writing required a high level of abstractness. Finally, they concluded that it was the abstractness of written language which caused children to have difficulty with writing, not mechanical obstacles or underdevelopment of small muscles.

Within educational research, there have been primarily two approaches to the investigation of writing. Until the late 1960s, the mode to investigate writing was through evaluation and examination of writers' products. In 1969 Janet Emig introduced a new form of writing investigation through her case study "Composing Processes of Twelfth Grade Students." This new approach took into consideration the process of writing. Emig's research was soon followed by the publication of Donald Graves' dissertation study and

findings. By the mid-1970s, Graves, along with his colleagues, was conducting extensive research dealing with the writing process of elementary school children. This new form of investigation considered the final product but focused more on its evolution. Observation centered on the writing process itself, what the writer did as the composition took form, and environmental factors related to composing. Investigators were now looking at many of the variables one finds in a writing environment. The research of these investigators along with that of Luria and Vygotsky provides us with a baseline for the study of the writing process.

Of interest is that during the 1920's, Vygotsky (1978) had written about the importance of observing process in research:

In summary, then, the aim of psychological analysis and its essential factors are as follows: (1) process analysis as opposed to object analysis; (2) analysis that reveals real, causal or dynamic relations as opposed to enumeration of a process's outer features, that is, explanatory, not descriptive, analysis; and (3) developmental analysis that returns to the source and reconstructs all the points in the development of a given structure. (p. 65)

During the 1980's Harste et al. (1984) follow a similar direction: "Based on our experience, we advocate use of open-ended, real language situations in which the child, or language user, becomes the research and curricular informant" (p. 51).

The seeds of writing are there early in the development and growth of children. Over fifty years ago Vygotsky (1978) wrote:

The gesture is the initial visual sign that contains the child's future writing as an acorn contains a future oak. Gestures, it has been correctly said, are writing in air, and written signs frequently are simply gestures that have been fixed. (p. 107)

These early seeds of writing are not only seen in gestures, but also in play, speech, and drawing (Atkins, 1984). It is obvious that writing, along with the other components of literacy, is a natural part of human growth and development. Baghban (1984) shares:

We continue to learn during our entire lives through speaking and listening and, in a print laden society, through reading and writing. We grow and change, and our language grows and changes with us. Living is itself a process. Thus, language as a means for survival, growth, and pleasure is likewise a process. (p. 3)

Writing is holistically intertwined with the other components of literacy and influenced by one's environment. This process begins when children are very young (Atkins, 1984; Calkins, 1986; Graves, 1983; Froese, 1978; Holdaway, 1979, 1984; Wellman, 1982). Calkins (1985) writes: "... current research has shown that youngsters are writing long before they come to school" (p. 26). Harste et al. (1984) state in reference to their research:

These data support the notion that young children are written language users and learners long before they receive formal instruction and

that they actively attend to written language; in short, there is literacy before schooling. (p. 82)

Luria (1978) held similar conclusions years ago:

The moment a child begins to write his first school exercises in his notebook is not actually the first stage in the development of writing. The origins of this process go far back into the prehistory of the development of the higher forms of a child's behavior: we can even say that when a child enters school he has already acquired a wealth of skills and abilities that will enable him to learn to write within a relatively short time. (p. 65)

To young children, writing is initially approached from a holistic perspective (Atkins, 1984; Clay, 1975). A few scribbles on a paper may mean an entire book, story, or long letter to grandma (DeFord & Harste 1982). To young children the accomplishment of writing their own name has more meaning and value to them than just the visual sign. They make a holistic assumption of what their name means. Young children interpret this symbol to represent all their personal characteristics, "My Sign," "My Name". This is a symbol or sign of "me-ness" to a young child. As their understanding of language and print literacy matures, children move along a continuum of development, first representing whole thoughts through a mark on a piece of paper, later a letter, groups of letters, a few words, phrases, sentences and eventually stories (Clay, 1975; Harste, et al., 1984; Luria, 1978; Wood, 1982).

Logically it follows, and researchers have found, that mechanics is secondary to meaning in importance to young

children in their writing (Calkins, 1983, 1986; Forester, 1980; Luria, 1978; Milz, 1980). Luria (1978) writes:

One thing seems clear from our analysis of the use of signs and its origins in the child: it is not understanding that generates the act, but far more the act that gives birth to understanding - indeed, the act often far precedes understanding. (p. 113)

This appears to reflect that young children's writing is holistic. As previously written in the language and cognition section, it is difficult for a young child to consider the whole and parts simultaneously. Of primary importance for children is to communicate the message. As children's understanding of print literacy grows, they begin to use the sound/symbol relationship as defined by our society, the English language. Schieffelin and Cochran-Smith (1984) write: "In these (early) literacy events, children's control of the uses of print preceded their control of the mechanical skills of decoding and encoding" (p. 8).

Recognizing a child's cognitive stage and related processes are important to an investigator's understanding of a child's growth and the writing process. Children interpret, define, edit and revise at the cognitive stage where they are developmentally. Revision of writing may be done abstractly by older students or adults, but young children look at it concretely and may not see where changes should occur (Calkins, 1983; Ferreiro & Teberosky, 1984). Initially, young children concentrate on the physical aspects

of writing, and as they begin to mature, there is a growth of covert abstract behaviors. An important consideration for young writers is what occurs now, not necessarily what has already transpired.

There are many rules and conventions one must learn in order to write. For a young child there is so little understanding of the system and so many rules and conventions to be learned (Clay, 1975; Luria, 1978). These rules of order are learned intrinsically--they arise from the individual's interaction with the environment (Chomsky in Piattelli-Palmarini, 1980), what Harste et al. (1984) refer to as the socio-psycholinguistic process. As rules and conventions are learned, tested, and generalized, they allow the writer to make changes in his/her work (Templeton, 1980). Generalizations by children are often overdone and may change the perception originally intended for a piece. An example of an over generalization at this transition age is the use of silent e. The different meanings of hop and hope can drastically influence the intent of a piece.

Harste et al. (1984), "... the young child is a written language user long before his writing looks representational" (p. 16). Children need only a few letters in order to begin writing (Chomsky, 1971; Graves, 1983). Therefore, spelling, a subskill of composition, is often incorrect. Even though words are often misspelled, children are generally following language rules and conventions as they know them (Hayes &

Plaskon, 1982). At other times, some of the misspelling, as well as use of words, may be a result of their play and experimentation with sounds, letters and vocabulary (Clay, 1975; Forester, 1980). Such play and experimentation also occurs with other written language rules and conventions. Moving left to right and top to bottom on a page must be learned for writing English. At times, young writers will try to reverse a newly learned rule, e.g., write right to left. Even though children are able to begin writing knowing only a few letters, there is continuous and extensive learning required to understand additional rules and conventions and to experience the writing process.

Investigators often make reference to a child's first year of writing as occurring during grade one, and that it is during this year one observes children making the most progress (Atkins, 1984; Calkins, 1986; Graves, 1983; Milz, 1980). There is understandably a great deal of change in what we see in children's writing development during the ages of 5, 6, and 7. During these early school years, children begin to see themselves as writers (Calkins, 1985, 1986). Also during this chronological period parents will recognize that their child is writing messages and complete thoughts. What we often do not realize and recognize is the child's understanding of literacy and the covert effort put into such development as a preschooler. After observing her daughter's first three years of life, Marcia Baghban (1984) has written

of the tremendous literacy growth her daughter made including the understanding of print and symbols. Writing becomes overt during the early school years. Adults recognize the child's compositions as now being more adult-like as their writing begins to approximate standard English.

Many researchers have come to realize the extensive amount of cognition that occurs as an individual writes (Atkins, 1984; Calkins, 1986; Clay, 1975; Graves, 1983; Olson, 1984; Vygotsky, 1962). Vygotsky (1962) has written: "Writing also requires deliberate analytical action on the part of the child" (p. 99), while Dalute (1985) states: "Writing is a cognitive process" (p. 52). A writer has a holistic concept in mind when pen is put to paper or fingers to keyboard. As the author begins, s/he must make decisions and solve problems as to how s/he will communicate with his/her audience. Once the process of writing begins, it becomes a problem solving task (Atkins, 1984; Calkins, 1986; Graves, 1983). Atkins (1984) has written: "Any given piece involves a continuous interplay of many elements-thinking, writing, reading, rethinking, rewriting, rereading, and so forth" (p. 6). Some scholars have written that writing is a tool for heightening and refining thinking (Calkins, 1983; Olson, 1984).

Writing allows researchers the opportunity to observe people thinking (Calkins, 1983; Dalute, 1985; Olson, 1984). As authors write, they ask questions of themselves,

attempting to consider their audience, their intended message and conventions of written language. All of the categories in Bloom's cognitive domain are used by writers (Olson, 1984). In particular, the higher processes of cognition are required when writing; analysis, synthesis, and evaluation. These cognitive processes are used as an author writes, reads, rewrites, rereads, and continually repeats these literacy processes again and again.

An outcome of writing and its attendant cognitive processes is learning. Graves (1983) writes: "Growth comes when problems are solved by child or adult" (p. 233). As children toil with their compositions, they not only think, but are intrinsically motivated to make decisions about their creations. These experiences and problem solving events evolve into knowledge which can be of use in other writing and literacy activities. Once children experience these problem solving processes, they often share their knowledge with others (Calkins, 1983, 1986; Graves, 1983). Dyson and Genishi (1980) observed benefits for those who desire to work around others; a group provides models, assistance, and encouragement.

During the early 1980's, Dyson and Genishi (1982) investigated the verbal interactions associated with writing among first grade students. Among their findings is the recognition that children have different approaches to writing. Some children tend to work alone, while others

desire the support of a group. They also observed that all the children listened to their own speech in order to bridge oral and written communication.

Another factor influential to the writing process is content. Investigators feel that the relevance of writing material, the topic, is an important factor in children's composition (Allen, 1976; Donaldson, 1978; Harste, et al., 1984; Vygotsky, 1978). Many investigators have discovered the importance of and promote children choosing their own writing topics (Calkins, 1983, 1986; Graves, 1983). Allowing children to choose their own topics provides them with the opportunity to decide on something which is of significance to them. If young writers are permitted to choose a topic to write about, the child does not only develop a sense of ownership, but becomes internally motivated to produce a quality product (Sorensen & Kerstetter, 1979; Toth, 1982). This allows the educator to cultivate the fertile interests and inclinations of the child in his/her written work instead of imposing instruction from without (Holdaway, 1984; Vygotsky, 1978).

Related to children choosing their own topics is the amount of time children spend writing. In the past, when topics and instruction were imposed, writing did not occur for very long and work on compositions rarely carried over from one day to another. Where there is an understanding that writing is a developmental process and children are

allowed and encouraged to choose topics, investigators have found children spending tremendous amounts of time writing (Calkins, 1983; Graves, 1983). This commitment to writing is found not only during classroom time -- children have been observed spending their own time as well (Calkins, 1983). The time spent is on all phases of the writing process and often extends from one day to another on one topic or composition. It appears that, when allowed and encouraged, children will dedicate a great deal of time and effort to writing.

Although Luria and Vygotsky's work was published in the West during the last two decades, their work had begun in the 1920's. From then until the 1970's, little writing investigation had been completed. During the past 15 years, research on writing has moved from a focus on product to an observation of the total print literacy environment including an individual's process of writing. Much of this research, as well as that of Vygotsky's, has included a perspective on the importance of cognition in the writing process. Present research demonstrates that writing is a component of literacy which is a socio-psycholinguistic process. We begin as young children to scribble and draw with and on what ever material is available. Reinventing through discovery children generate the rules and conventions of their native language and continue to expand their knowledge and understanding as they become ever more efficiently literate.

In Clay's (1975) book What Did I Write?, she describes a general sequence of developmental writing behaviors she has observed in young children whose print literacy is evolving. From these developmental sequences, she has designed three scales for determining children's early writing progress. Of her proposed three scales, one does not apply to this research, "DIRECTIONAL PRINCIPLES," which is a referent to the directions in which children write across paper. Writing direction with a word processor is determined by the software. Figure 2.1 contains two of Clay's scales, LANGUAGE LEVEL AND MESSAGE QUALITY. Each of these scales include short defining statements.

LANGUAGE LEVEL: Record the number of the highest level of linguistic organization used by the child.

1. Alphabetic (letters only)
2. Word (any recognisable word)
3. Word Group (any two word phrase)
4. Sentence (any simple sentence)
5. Punctuated story (of two or more sentences)
6. Paragraphed story (two themes)

MESSAGE QUALITY: Record the number below for the best description of the child's sample.

1. He has a concept of signs (uses letters, invents letters, uses punctuation.)
2. He has a concept that a message is conveyed (ie he tells you a message but what he has written is not that message).
3. A message is copied, and he knows more or less what that message says.
4. Repetitive, independent use of sentence patterns like 'here is a ...'
5. Attempts to record own ideas, mostly independently.
6. Successful composition

Figure 2.1 Two of Marie Clay's (1975) arbitrary rating scales from her book What Did I Write?, subtitled "Beginning Writing Behaviour" (p. 66).

Luria (1978) has also written of stages children experience in their evolutionary development of literacy. He shares:

Lines and scribbles are replaced by figures and pictures, and these give way to signs. In this sequence of events lies the entire path of development of writing in both the history of nations and the development of the child. (p. 83)

Using Clay (1975), Luria's (1978), and other scholars' work I propose that young children move along a developmental writing continuum similar to the one which follows (Graves, 1984; Holdaway, 1979, 1984). Although I present this developmental sequence, I do not envision this as stages which all children must progress through. Instead, I present this as an evolutionary continuum which budding literates experience. My proposed continuum is presented in reference to Harste et al. (1984):

Current yardsticks divert attention away from growth and toward 'developmental stages,' which attempt to calculate growth by marking surface level features of conventional form. Such a focus draws our attention away from the universals of written language literacy, which operate across language users at all ages and simply express themselves in a variety of alternative forms. It limits our thinking about literacy. Literacy becomes a step-by-step progression of control, not a vehicle for exploring and expanding our world. (p. 12)

1. Scribbles
2. Scribbles & Pictures
3. Copy
 (name, alphabet, numbers, words)
4. Name
 (write own name)
5. Word
 (inventive recognizable word)
 initially without vowels
 later with vowels
6. Word Group
 (two or more word phrase)
7. Sentence
 (a simple sentence)
8. Story
 (two or more sentences)
9. Punctuated Story
 (story with appropriate punctuation)
10. Paragraphed Story
 (story with more than one theme)

Figure 2.2 Writing behaviors of children in a print-laden society.
This author's interpretation based upon readings and observation.

It has been suggested by previous researchers that with the use of pencils, pens, crayons, paper, etc. (writing tools) children explore with their writing implements and progress through stages of writing development. Now with the advent of electronic technology and its use by children developing their literacy, is there a common print literacy developmental sequence children experience as they write with a word processor and how does this relate to earlier research of older writing technologies?

COMPUTER RESEARCH RELATED TO WRITING

Beginning in the late 1970's, microcomputers burst into the consciousness of modern men and women. Ever since, the microcomputer has been touted as a resource for everything and a machine no one should go without. Educators, primarily from the fields of science and math, began to implement the use of these machines in their curriculum. Following microcomputer use in math and the natural sciences, other educators have slowly begun to employ this tool in various areas of the curriculum including language arts and the literacy component, writing. Scholars have written glowingly of the possibilities for this new writing machine (Bradley, 1982; Christensen, 1983; Daiute, 1983, 1985; Eagan, 1984; Fisher, 1983; Halpern, 1984; Olds, 1985; Papert, 1980; J. Smith, 1983). Donald Graves (Green, 1984) has stated: "I think marvelous things can be done with the computer as a word processor..." (p. 21), while Don Holdaway (1984) shares:

... the mini-computer and word-processor, because they carry the competence to store and edit, represent a breakthrough for composition, and young children seem to have remarkable facility in learning to handle computers. (p. 28)

Although there are many enthusiastic supporters, very little investigation of the word processing tool and early writing has occurred (Kurth, 1984; Miller, 1984; Watt, 1983). Now in the mid 1980's, scholars and researchers are beginning to question, investigate, and predict the impact of

microcomputers on the writing process (Daiute, 1985; Green, 1984; Holdaway, 1984; Zinsser, 1983). This section is a literature review of computers as they relate to young children's writing.

Information about the history and development of computers and other writing implements is available elsewhere (Alessi & Trollip, 1985; Boorstin, 1983; Oxenham, 1980). Of interest, is that as humans have continued to generate more information, early computers were constructed to store and manipulate various types of records and large amounts of data. Such use is similar to the impetus of our ancestors' first use of writing, record keeping. In reference to our ancestors' development of writing, Kust (1981) states:

It is thought that this complex economic organization begot writing. Records of production and revenues, property and water rights had to be kept. Commerce and trade in the cities called for written contracts. In fact, most of the oldest tablets are concerned with economic matters. (p. 471)

There are various types of writing software available (Anderson-Inman, 1986; Gallagher, 1985; Humes, 1982; Marcus, 1983; Shostak, 1983). Some programs have been designed for large mainframe computers, while versions of these or new ones have been designed for microcomputers. Miller (1985), while conducting a survey of the early 1980's literature, used four categories to classify the teaching of writing with computers: (1) computer-prompted idea generation, (2) text analysis, (3) computer-assisted instruction, and (4) word

processing (c. 2). None of these categories have received an abundance of investigation.

In the category of word processing there are four basic subcategories: (1) text editors, (2) batch-formatting programs, (3) online formatters and advanced online formatters, and (4) integrated word-processing programs (Pfaffenberger, 1986). Text editors and batch-formatting programs were designed and used before the advent of microcomputers. When using a text editor, compositions are simply written as text files and contain only the symbols of keys available on a computer's keyboard. A batch-formatting program allows one to feed a text into a computer, wait for the document to be processed and then receive a hard copy from the printer. Beginning in the late 1970s, online formatters became available with the development of microcomputers. Online formatters allow a writer interactive control of the composition s/he is writing. The most recent form of word processing is the integrated program. Such a program not only provides interactive control, but also may furnish the use of a dictionary, spelling checker, thesaurus, data base, spread sheet or idea processor.

Text analysis and batch-formatting programs were originally designed for and used with mainframe computers. The less expensive microcomputer was not publicly available until the late 1970's. With the advent of microcomputers and the utility of online formatters and integrated word

processing programs, educational institutions began to acquire and use this new technology. Also, microcomputers have been slow to be accepted and used in the language arts curriculum areas of most schools. Since online formatters and integrated word processing programs are less than a decade old, and fairly new to those in the language arts portion of the curriculum, it is understandable that there has not been an abundance of investigation related to the use of these tools. Yetta Goodman (1984) writes:

The impact of home minicomputers and the new computer age in general on the functional principles of literacy that children develop can only be speculated about at this time (...), but that this understanding of literacy will appear in the play and real use of written language by children between the ages of 2 and 6 is unquestionable. (p. 107)

Dillon (1985) shares:

While we know little about language and learning in classrooms generally, we know even less about the structure of knowledge and style of language in computer software and how pupils interact with it in order to learn. (p. 96)

Though research is not extensive on the use of word processing, some documentary literature is available, written by those experienced with the use of this tool. In his book Writing With A Word Processor, author William Zinsser (1983) writes of his computer purchase and use of a word processor in the early 1980's. Among his findings: (Zinsser 1983), "Another novelty that I hadn't expected is that the word processor makes writing a public act" (p. 44). Monitor

screens provide a visual display of text or graphics associated with the software being used with the computer. The cathode ray tube (CRT), synonymous with monitor and television, is a common artifact in today's society. Not only do most Americans possess a television, they are also present in many commercial settings. From walking in the door of a business and seeing oneself on a monitor to watching the latest styles dance across the TV screen at a fashion boutique, we have become familiar with the universality of television viewing. As Zinsser and others have reported, writing with a word processor places the writing process in the public domain (Bickel, 1985; Bruce, Michaels & Watson-Gegeo, 1985; Daiute, 1985; McKenna, 1986; Worsley, 1985).

Scholars have written of changes they have experienced, or which they envision will occur when using a word processor (Arms, 1983; Blask, 1986; Branan, 1984; Bridwell, 1984; Crist, 1984; Halpern, 1984; Marshall, 1984; Papert, 1983; Schwartz, 1982; Spencer & Baskin, 1983; Thompson, 1983; Watt, 1983). After Jamieson McKenzie (1984) completed his dissertation using a word processor he wrote,

Those who spend hundreds of hours writing with the word processor can report major transformations of style, productivity, and process. Fluency grows, flexibility develops, and originality springs from its hiding places. Liberation from the fear of errors can set creative expression in action. (p. 56)

This, from an initial investigation into the use of word processors, and at an adult level.

Research conducted on the use of word processors in writing has been done at all levels of education. At the secondary level (middle school through college) many of the investigators have noted changes in students practice of revision (Piper, 1984; Selfe, 1985; Simon, 1984). Among Diane Ehrlich's (1985) observations of junior college students, she notes that they revised more holistically and not just at the surface level. Ann Duling (1985) observed among 9th grade subjects that "Students were found to have made significantly more revisions at the sentence and multi-sentence levels of their texts than expected." Another researcher found that middle school students apparently spend more time in revising their text than through traditional means (Koenig, 1985).

Teachers have written of the changes and advantages their students have experienced using a word processor (Bickel, 1985; Selfe, 1985). Gail Womble (1985), a high school teacher has expressed it as follows:

How does a word processor affect student writing? I'm able to make several observations:

1. I've observed that students using a word processor often become more fluent writers.
2. The changes students make in their writing tend, at first, to be surface level (editing). Until they have had experience with 'real' revision, they tend to 'revise' the way they know how, by correcting mechanics or recopying to make their papers look neater. The word

processor helps these students to stay longer with a piece of writing and to experiment more with additions, deletions, etc. These changes can be made easily and feedback is instantaneous.

3. With clean and readable copy, writers are better able to continue on to the important business of revision. Problems with handwriting and illegibility are no longer obstacles.
4. Many students will choose not to revise at all if revising means going to all the extra work of recopying page after page. The word processor saves them from copying and recopying every time they make a change.
5. Writing with the word processor helps students become more aware personally of writing as a process. They are able to articulate clearly and decisively the process they follow. (p. 76)

Exploratory research on the use of microcomputers with word processing programs has been conducted in various settings. These settings range from solo computers in a classroom to computer labs containing multiple microcomputers or terminals (Arms, 1983; V.N. Bradley, 1982; Brent, 1985; Ehrlich, 1985; Heap, 1986; Miller, 1984). These variations have also occurred across levels of education although there appears to be more investigation conducted in lab settings at the secondary level.

Of the investigations conducted with elementary age students, a trend emerges; older students have access to a computer lab while younger children use a computer in their classroom. Subjects in Sam Miller's (1984) research, sixth graders, wrote in a lab setting. Phenix and Hannan's (1984) subjects, first graders, had the use of one microcomputer in their classroom. Such a discrepancy in computer availability

appears to be the norm except for a few schools using IBM's "Writing to Read" program (Educator's Report, 1986; Guttinger, 1986; Ohanian, 1984; Powell, 1984; Wallace, 1985).

Bradley (1982) reports on two exploratory studies dealing with the use of word processors in elementary schools. One study investigated sixth graders using word processors for combining sentences. The other centered on the usefulness of a word processor and the language experience approach (LEA). In the LEA study, adults took dictation from individual first grade students during a small group setting, word processed the stories and printed copies for each member of the group. Although these young students did not have an opportunity to directly handle the equipment, they were apparently influenced through this experience. Significant aspects to this study reported by Bradley are, (1) children had the experience of seeing how quickly their dictation was transcribed, (2) each of the stories was longer than a typical LEA story, (3) the ease at which children could make changes and corrections as they created stories was demonstrated, (4) and also shown was the computer's capability to produce hard copies. Each of these outcomes was a learning factor in each child's understanding of a computer and the word processing tool.

In a study conducted by Phenix and Hannan (1984), children in a grade one classroom were told at the beginning of school in September that they were expected to write daily

throughout the year. Later in the Fall, most children had an opportunity to be involved in a six-week pilot classroom project using a computer system with word processor. Through their investigation, Phenix and Hannan (1984) observed a number of different phenomena relating to both print literacy and computers. One of the findings of this study demonstrated that reading and writing are intertwined. An initial activity observed by Phenix and Hannan (1984) was that children would retrieve their work from the previous day and reread what they had written. They also found that, in most cases, children would continue with the writing which they had begun the previous day. As others have speculated, children were also spending more time composing, apparently due to their enjoyment of using the computer (Eagan, 1984; Fisher, 1983; Kurth, 1984; Sommers & Collins, 1984). By reading, rewriting and continuing their work from the previous day, children integrated the development of literacy skills.

In relationship to the ease of revision, Phenix and Hannan (1984), as well as others, observed that this tool allowed children to take risks in their writing (Worley, 1984). These first graders always had the opportunity to easily and effortlessly erase part or all of a word, sentence or thought (Humes, 1982).

Phenix required her students to print hard copies daily. This procedure afforded children the opportunity to see their

own successive drafts. Also, as others have speculated, as they compared these drafts, the children evolved an awareness of the manipulative possibilities of letters, words, sentences and thoughts (Crist, 1984; Marshall, 1984; Olds, 1985; Piper, 1983-84; N. Smith, 1985; Worley, 1984).

Phenix and Hannan (1984) also report transfer of writing concepts by students. When the word processor was not available, children continued to be concerned with grammar, punctuation, and spelling as well as to rewrite, insert, and delete in their handwritten compositions. Phenix and Hannan (1984) write:

They had learned that writing does not have to come out right the first time, that it can be manipulated by the author, that a writer has to take risks, that revising is the normal way writing is done. (p. 812)

An additional composing skill that children were observed developing was formatting. Within a few days of using the word processor, children were aware of the importance of space within their compositions. Students realized the use of space for separating words. In conjunction with formatting, a printed copy of the composition appears perfect. This allowed children to easily identify printed letters, words and thoughts.

Phenix and Hannan (1984) observed all phases of the writing process during their classroom investigation. Children of varied abilities and experiences used this new technology. In summary the investigators (1984) write:

The children we observed were already practiced in composing, through their talk, dramatic play, painting, and their experiences with literature. When their writing was not limited by their ability to print and spell, the length, fluency, and literary quality of their pieces increased. In turn, the quantity writing led to better facility with printing, and a development towards standard spelling. The computer proved to be a powerful tool in enhancing the children's composing and transcribing skills. (p. 812)

In another school setting with first grade children, The Bank Street Writer word processing program was used with bilingual children to assist in the development of their English literacy. Children had the opportunity to spend approximately 15 hours over a three month period towards the end of the school year writing with computers. Brisk and her colleagues (1985) intended their educational approach to teach students the value of writing, to tell a story.

In this study, the investigators found that they could classify the skills of the children during the students' initial encounter with the computer.

Some used the word processor without hesitation and with a fair degree of accuracy. Others seemed to recognize the letters, but took some time to write. Still others wrote with great difficulty. And a few had problems writing but could still accurately prompt peers when they were having difficulty. (p. 27)

However, Brisk (1985) writes: "Language and reading ability did not always relate to students' initial reaction or ability to use the word processor" (p. 27). In addition, during their initial interactions with the word processor, students were observed to have some difficulty with the

mechanics of this new technology. Students soon discovered that pressing a key for too long resulted in repeated letters. Since the keys on a keyboard are pictured as capitals, this caused some confusion. The most obvious difficulty is that capital "I" is often interpreted by children as a lower case "l".

Although the emphasis was not on teaching word processing skills, many of the children learned to perform such skills to varying degrees. During this project, teachers explained editing and printing procedures to the children as they performed them. Instructions written on poster board in Spanish were displayed in the room. As children continued to work in this environment, many eventually learned to manipulate the word processing software functions.

Just as Phenix and Hannan (1984) observed, Brisk and her colleagues (1985) report some children simply wrote letters, numbers, words or combinations of these without any particular meaning. Brisk (1985) explains that these were the less advanced students. Another interesting concept Brisk (1985) reports is that "Neither the word processor nor the printer revealed the identity of the 'real' author" (p. 28). Children could work together, copy another's writing, work with an adult, and then print their composition. The resulting letters, numbers, words or combination of these did not necessarily reveal the "real" author.

The popular press in the past has often voiced a concern related to the "social disassociation" that computers will have on children. Word pictures have been drawn of a child isolated and detached from reality in his or her room concentrating on a computer. Brisk (1985) and her colleagues found that children were not isolated in their work with a word processor. There were constant interactions among adults and children. Adult exchanges appear generally to be in the realm of assistance with either the mechanics of the word processor program or with composition. Children became peer tutors as they helped one another. Brisk (1985) and others have found that there are many opportunities for children to discuss concepts and language while they compose with a word processor (Kurth, 1984; Mehan, 1984).

Brisk (1985) and her colleagues attempted to create a risk-free environment where children could experiment with written and oral language, and to allow for the natural development of literacy. The children involved in this project represented all ability levels. In conclusion the author writes, "This project demonstrates that the computer can be used to develop literacy among very young children regardless of their initial ability to read or write" (p. 31).

The researcher Heap (1986) designed a study to observe first grade students and their collaborative practices when writing with a word processor. In the research setting,

while students were involved with the word processor they also had a "helper" student ready to assist. Heap (1986) writes:

The helper position in the classroom arises somewhat spontaneously, according to the teacher. Each year in her class, the students who are the quickest to pick up the fundamentals of using the computer for story writing hang around the computer offering advice, until an actual position called "helper" is institutionalized by the teacher. (p. 2)

Thus there were two people working together at the word processor collaborating on a written composition.

Heap (1986) found children interacting with one another when composing and that their writing process became "... bi-modal. It was done as physical acts, of finding and depressing keys, but also as verbal acts of pronouncing the letter being input" (p. 8). Both the writer would say the letter names or words to him/herself as the text was inputted or the helper would share the discussed text verbally. Heap also writes that the children coordinated their writing and suggestions very carefully as they worked together: "I observed no cases of a student dictating an entire word, or a sequence of letters, without timing the delivery of the dictation to alternate with inputting" (p. 17).

Heap (1986) also found that children's verbal sharing extended to their arrangement of text. They would tell one another what was needed were in order to format the text the way they wanted it. This included telling where to leave a

space. Heap (1986) points out that in stylus writing the author leaves a space whereas with a word processor the author puts a space where needed. In conjunction with putting spaces and use of the space bar, Heap (1986) found: "Arranging, as it was done by the first graders I observed, primarily involved cursor movements and deletions" (p. 20).

During this study Heap (1986) became aware of the many language arts skills children utilized as they collaborated with one another.

Word processing ... virtually requiring, students writing together to use all of the language arts. During my observations, students spoke. They listened. They obviously wrote, but, as the prevalent oral reading practice made clear, they also read what they had verbally composed and verbally input. Hence, the use of the computer had a value that transcended development of the single language art which computer writing would otherwise appear to serve. (p. 24)

Seymour Papert (1980) and others (B. Bradley, 1983; Dillon, 1985; Schantz, 1983; Worsley, 1985) write of "empowerment" for children in their use and control of computers. Investigations into this concept of "empowerment" have occurred by focusing on the concept of locus of control (LOC) (Louie, 1985). CAI (Computer-Assisted Instruction) and related courseware materials control the teaching situation and students (Alessi & Trollip, 1985). Students respond to visual stimulus from the screen or auditory stimulus from an attached electronic speaker. The courseware continues to prompt students through its program of instruction, waiting

and only allowing certain responses. In this fashion, students are controlled by the electronic media and hardware. In their study of young bilingual children, Brisk (1985), notes, "Word processing permits children to impose standards and limits rather than imposing rules on them" (p. 32). Children are in control of the computer and courseware through the use of interactive software such as a word processing program (Newman, 1984B; Piper, 1984; Schantz, 1983).

In summary, there are many exciting possibilities for the use of computers in our world (Evans, 1979; Toffler, 1980). Microcomputers, using word processing software, appear to hold great promise for the development and use of literacy skills. Goelman (1984) summarizes notes from a recent symposium on literacy: "Computers could have profound effects on society in general and literacy in particular" (p. 211). When using a word processor, writing suddenly becomes public. A word processor also allows one to take risks and easily play with written language. And when used in conjunction with process writing Daiute (1985) states: "The computer is the perfect tool for a process approach to writing, because it makes revising and recopying texts physically easy" (p. 66). Brisk (1985), Clements, 1987; Heap (1986), as well as Phenix and Hannan (1984) have demonstrated that First Grade students can use a word processor. Even

though research is limited, scholars have written glowingly of the use of these tools in education.

SUMMARY

The evolution of the human species' literacy and cognitive development has been continuous for thousands of years. An outgrowth of our early thinking and initial oral and gesture communication was and is the evolution of writing. At different points during this evolution, technological changes have revolutionized the development of literacy. Presently, we are at the beginning of another technological revolution which may have tremendous impact upon human cognitive and literacy growth and development.

Other than those first precious five years of life, the following two to three years hold the most extensive cognitive and literacy development for humans. During these years, children move from the preoperational stage of cognitive development to the concrete stage. Their literacy development is characterized by a greater understanding and use of rules and conventions associated with written language.

During the last 15 years there has been a reexamination and investigation of the human species' writing process by educational scholars. The writing process is not only an aspect of mature writers, but that of developing writers as well. During this same time period our species has developed

a new literacy tool, the computer. When programmed with word processing software, the computer has the potential to allow easy manipulation of words, phrases, and thoughts. Many glowing reports have been written about this so often revered tool. However, few empirical studies have been conducted. There has been little investigation into young childrens' use of a word processor associated with their print literacy development.

The findings of this study may provide further understanding of young children's use of a word processor as our society evolves into the Information Age.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

INTRODUCTION

Wilson (1977) writes: "There is a growing interest in the use of anthropological techniques in educational and psychological research" (p. 245). Ethnography, descriptive, and naturalistic inquiry - "qualitative research" - is increasingly being used in classrooms and schools throughout the United States as an investigative method. Wolcott (1984) states:

If descriptive research--or 'qualitative' research, as it is fortuitously called--is not about to unseat quantitative research as education's king of the mountain, it has at least earned a place as one of education's legitimate and important ways of knowing (p. 177).

Two other scholars, Guba and Lincoln (1981), writing about the usefulness and importance of naturalistic inquiry state: "It is our position that the naturalistic paradigm is the more useful for all social-behavioral inquiry and certainly for responsive naturalistic evaluation" (p. 56).

During the past 100 years, a number of naturalistic studies in the field of psychology have provided a basis for related investigative methods. As Agnew and Pyke (1969) write:

The work of Piaget, the famous child psychologist, and that of Sigmund Freud was based on the method of naturalistic observation, and is the foundation for much of the current research in some areas of psychology today. Although at times this method is comparable to a crude sieve, it is still a valuable source of important and durable data in the hands of a skilled researcher (p. 63).

Ethnography offers useful tools in social science evaluation and research. Ethnographic techniques are increasingly being included in present day educational research and evaluation. Fetterman (1984) writes: "... ethnographic techniques in particular have been used successfully to provide useful insights into numerous educational and social problems" (p. 13). The use of ethnography as a research method in education has also been documented by Wolcott (1984) who suggests it is important

...to help educators recognize the value of descriptive research conducted in natural settings rather than to rely so wholeheartedly on experimental research in contrived or controlled settings (p. 177).

Descriptive research in a natural setting has been an important component to recent investigations of children's writing (Baghban, 1984; Bissex, 1980; Calkins, 1983; Graves, 1983, 1984; Harste, et al. 1984; Heap, 1986). Donald Graves (1984) shares: "Writing is an organic process that defies fragmentary approaches to explain its meaning ..." (p. 96). This initial research of the writing process has eventually led to a change in the way writing is perceived and taught in many American schools. In her book Lessons From A Child,

Calkins (1983) describes her use of case study to follow Susie, her subject, through two years of writing development and evaluation. Such an approach is typical of inquiry into a relatively new field or area of study. Kosecoff and Fink (1982) write:

Evaluators typically use case designs to answer questions that ask for a description of a program's participants, goals, activities, and results. Questions about new programs or demonstration projects for which comparisons are not yet available almost always require case design strategies (p. 81).

The use of computers and especially microcomputers in education is a recent phenomenon. As demonstrated in Chapter II, little investigation has been conducted on the relationship of children's literacy development and the use of microcomputers programmed for word processing. Since little is known empirically, it is important to conduct research in this and other educational areas influenced by technology (Daiute, 1985; Sheingold, 1983; Spencer, et al., 1983; Weizenbaum, 1983). Halpern and Liggett (1984) write:

Topics for research in technological change are as diverse as the new technologies themselves. ... many intriguing questions about the effects of the new technology on writing remain (p. 85).

Collins (1985) further clarifies the issue of investigative approach and the association of children's literacy development and technology:

If we wish to learn about the role of computers in child literacy and their effect on children's learning and 'linguaging', we'll need to spend much time in classrooms with children and

computers to study closely and carefully what happens there. Despite the amazing degree of interest in computers, I have found very little work describing and analysing what actually happens with them in classrooms, ... (p. 102).

Two investigations, with concerns similar to those addressed by my research, have been reported. Both studies were with first grade students. The Brisk (1984) investigation was conducted over a three month period, with first grade children having approximately 15 hours contact with a word processor in a computer lab. Phenix and Hannan (1984) had one computer available in a grade one classroom for six weeks. This study focused on children one year younger, kindergarten students, who had daily access to a word processing center in a literacy lab over a five month period. Although a portion of this research has been a verification of these earlier investigations, Moore & Cooper (1982) write:

The findings of an individual research study, no matter how carefully done, or how relevant to practice, should not be given excessive weight by the practitioner. It is not until we have at least four or five studies, ideally more, all of which address the same general research question and suggest the same general conclusion, that we can have confidence in the statements to be made about behavior from our research (p. 8).

RESEARCH PROCEDURE

I modeled my research framework in part after that of Donald Graves (1984) of the University of New Hampshire, and his suggested approach to the study of the writing process.

He proposes that the study of process is the most enlightening approach a researcher can take in his/her study of writing. Graves (1984) writes: "We need more information on child behaviors and decisions during the process, rather than through speculation on child activity during writing from writing products alone" (p. 93). A number of authorities have written extensively about their study of process through the technique of case study (Baghban, 1984; Bissex, 1980; Calkins, 1983; Chomsky, 1971; Harste (1985); Taylor, 1983). In regard to the investigation of process through the use of case study, Calkins (1983) writes:

My hope is that through closely observing one child's growth in writing, we'll learn to watch for and to respect each child's growth in writing. My hope is that by understanding the pathways one child has taken in learning to write, we may be able to discern and trust the pathways other children will take (p. 7).

Noted scholars of the qualitative approach to research suggest that although a research procedure is designed, this research method possesses an inherent quality of accepting change (Miles & Huberman, 1984; Wilson, 1977). Guba and Lincoln (1981) write:

Within the naturalistic paradigm a design can be specified only incompletely in advance. To specify it in detail would be to place constraints on the inquiry that are antithetical to the stance and purpose of the naturalist. The design emerges as the investigation proceeds; moreover, it is in constant flux as new information is gained and new insights are achieved (p. 73).

In his book, A Researcher Learns To Write, Donald Graves (1984) shares his approach to writing research with the following model. This model is in the shape of an equilateral triangle sectioned into four levels. As illustrated in Figure 3.1, the top two levels deal with process, which requires case study observation, while the lower two levels focus on analysis of product.

Figure 3.1 Example of Donald Graves's writing research study design.

Following Graves' model, Level 1 requires an indepth case study of one child. It requires an observation of a child prior to, throughout, and following interaction with word processing as the child's literacy continued to evolve. Graves (1984) writes: "... the full context of writing episodes are gathered from before a child writes until the child has had a response to his product" (p. 105). Children associated with Level 2 of this diagram are followed in a manner similar to Level 1. Research associated with subjects

in Levels 3 and 4 requires the collection and analysis of products only. Again, Graves (1984): "... product analysis is given to four classes within the same school building, but also including each of the first three levels of the study" (p. 105).

In this study, the researcher proposed to follow six students in a similar manner to Level 2 of the Graves' design. The selection of six children allowed the observation of students from varied backgrounds and of both genders. Subjects with a variety of backgrounds provided an opportunity to look for similarities and is a reflection of research setting's diversity. This design also protected this investigation in that if one or two students left the school, this study could continue with the remaining subjects.

Although there was only researcher and observer in this study, a variety of data collection methods and multiple observations were employed in order to reduce the amount of error in this investigation. Agnew and Pyke (1969) state:

... the same observer may try to observe the same event many times in order to ensure that he has noticed all the relevant details and to rule out the possibility that his initial observation was a once-in-a-lifetime event (p. 58).

The use of multiple avenues of data collection is supported by the writings of Diesing (1983): "The reason for having multiple types of data is that there are no infallible data in ethnography, nor anywhere in the social sciences" (p. 3).

PARTICIPANT OBSERVATION

The researcher's role during this study was not only that of research observer but also that of participant. As a member of the staff, where this research took place, one responsibility the researcher had was to provide leadership in the area of literacy development to the prekindergarten through second grade teaching staff. Therefore, the researcher is a member of the immediate school environment including the Writing Lab. Many students have known the researcher since their enrollment in the School's Kindergarten and some, since they attended the School's 4 Year Old program. The researcher was frequently in kindergarten classrooms, the Writing Lab, and other parts of the building. It was not unusual for students to observe him in a teaching or administrative role.

Various scholars have written about and defined the participant observer role (Fetterman, 1980; Guba & Lincoln, 1981; Shuter, 1976; Wilcox, 1982; Yin, 1984). Shuter (1976) writes:

Participant observation, ..., can be defined as a field strategy that simultaneously combines respondent and informant interviewing with direct participation and systematic observation (p. 3).

Another definition which more closely describes this researcher's involvement in this study has been written by Guba and Lincoln (1981):

We prefer to define participant observation as a form of inquiry in which the inquirer-the observer-is playing two roles. First of all, of course, he is an observer; as such, he is responsible to persons outside the milieu being observed. But he is also a genuine participant; that is, he is a member of the group, and he has a stake in the group's activity and the outcomes of that activity (p. 189).

Guba and Lincoln (1981) further describe the use of observation in research:

The basic methodological arguments for observation, then, may be summarized as these: observation (particularly participant observation) maximizes the inquirer's ability to grasp motives, beliefs, concerns, interests, unconscious behaviors, customs, and the like; observation (particularly participant observation) allows the inquirer to see the world as his subjects see it, to live in their time frames, to capture the phenomenon in and on its own terms, and to grasp the culture in its own natural, ongoing environment; observation (particularly participant observation) provides the inquirer with access to the emotional reactions of the group introspectively-that is, in a real sense it permits the observer to use himself as a data source; and observation (particularly participant observation) allows the observer to build on tacit knowledge, both his own and that of members of the group (p. 193).

The authors of Effective Evaluation, Guba and Lincoln (1981), provide a graphic, illustrated in Figure 3.2, which represents their interpretation of a subject's awareness and degree of an observer's interaction in the study setting.

Degree of observer's interaction with subjects	Subject's awareness	Overt	5	6	
		Covert	1	2	6
	Participant		1	2	2
					8
	Nonparticipant		3	4	4
			Natural	Contrived	
			Situation		(p. 196)

Figure 3.2 Example of Guba's and Lincoln's Figure 4. A Typology of Subject/Observer Relationships

In this study, subject's awareness was both overt and covert. Much of the time, students were aware of the researcher's presence while he was observing, recording data, and taking notes about their behaviors. However, there were times when they were not overtly aware of his participation in the word processing center and the Writing Lab. To further clarify the degree of the researcher's interaction with subjects, there were times when he was a participant in their learning and use of the word processors as well as times when he was strictly a nonparticipant.

The researcher was both a participant and an observer in this study.

PRELIMINARY RESEARCH ACTIVITIES

There were three data collecting components associated with this study. These components are delineated in Figure 3.3. The initial components were extremely helpful in

preparing for the formal observations and refining and analysis of the data.

Pre-preliminary Research

October through December 1985

Subjects: full class of first grade students

Survey of research methods, observational practice and design of data collection instruments.

Preliminary Research

January through December 1986

Subjects: 7 children moving from kindergarten to first grade during the year

Observation and data collection of kindergarten and first grade students and continued design of data collection instruments and refinement.

Formal Research

January through June 1987

Subjects: 6 kindergarten children

Observation and data collection of kindergarten students.

Figure 3.3 Time line display of the three data collection components to this study. Data collection was confined to the word processor center in the "Writing Lab."

Beginning in October of 1985, the researcher began to collect anecdotal recordings in the Writing Lab ("Writing To Read" Lab) at the school. Subjects at this time were first grade students who were completing a year's contact in the writing lab. They had been using word processors since the beginning of September. The researcher began these preliminary observations in order to better understand the research setting and the children's computer interactions, and to develop a research framework for recording data. These observations were helpful in the formulation of questions, the development of recording instruments and approach, and in establishing the investigator as a research participant observer. Perl (1983) writes:

It's commonplace to say that we'll never learn how to write solely by reading about it or studying what writers say about it, similarly budding ethnographers won't learn the methods and procedures of ethnography merely by reading or studying accounts of other anthropologists (p. 11).

Guba and Lincoln (1980) share:

Another way to train oneself for observation is to set tasks related to looking, listening, and recording skills and to keep performing those tasks until the confidence that goes with solid performance is achieved (p. 211).

This informal investigation led to additional preliminary investigation. Beginning in January 1986, the researcher employed the Graves model to begin an investigation of kindergarten children's use of a word processor and their literacy development. This preliminary investigation continued for one calendar year. From January to June 1986, during their last six months of kindergarten, the researcher studied seven children as they used word processing. He continued in September of that same year to observe the same subjects as they used these machines. These first four months of the subjects' first grade experience completed one calendar year of study.

The preliminary research which occurred during 1986 encompassed the first two levels of the Graves paradigm: 1, one-child case study; 2, five-student case studies (six were used in this study). The focus in these levels was process, which has also included an analysis of students' products. These case studies provided the researcher with an indepth

view of children developing their print literacy using a word processor. This approach provided an opportunity to practice naturalistic research techniques. It also provided an insight into many of the processes which the researcher anticipated would be observed during the formal data collection period (Guba & Lincoln, 1981). Through testing and use of the model and ethnographic techniques, the naturalistic research design was modified and the investigator's skills as a researcher and observer matured.

RESEARCH SETTING

The research setting was in an inner city early childhood education center (ECEC) in the Pacific Northwest of the United States. This particular school has a cosmopolitan enrollment with students ranging in age from four to eleven years of age. Four years ago, we were given the technology to establish an IBM "Writing To Read" Lab (Writing Lab), an early print literacy program authored by John Henry Martin (1984). The technology originally associated with this IBM program consisted of three computers dedicated to computer assisted instruction (CAI), 6 Selectric typewriters which students could use to copy their written work, and cassette tape playback machines functioning as listening posts for children's literature books and workbooks. Two and one half years ago the school was given six computers capable of using word processing software. As a result, the school's Writing

Lab contains six IBM PcJrs in addition to the original three computers primarily dedicated to CAI. These additional six computers comprise the word processor center. Within the word processor center, two printers are color coded and networked to the word processors. Each printer supports three word processors.

As illustrated in Figure 3.4, the school's writing lab contains eight learning centers in a two room complex. The main room contains the vast majority of students at any one time. A listening center, which can accommodate 4 to 6 children, is located in a small auxiliary room which is also used for storage. Unless they are specifically assigned, or a particular learning center is full, children have access to the entire writing lab.

Figure 3.4 Diagram of the school's writing lab depicting learning centers and position of the six word processors.

Associated with the school's writing lab is the IBM "Writing To Read" program and related software. This software is a CAI phonics program which also includes audio tapes and workbooks. The CAI phonics program consists of ten cycles, each introducing a few phonemes. Following CAI lessons with these phonemes, students must pass a computer mastery test in order to advance to the next cycle. Although

this software is available, the teaching focus is written and oral language immersion.

Bank Street Writer, the word processing software used with these computers, is capable of being presented in both monochrome and color displays. The monochrome screen consists of a black background with print and format items in all modes presented in white. Color screens also consist of a black background but include blue format lines and some print in different highlight colors. Color highlights are present in both the writing and edit modes.

Alternating daily and skipping every other computer, three of the computers were booted with software to produce monochrome screens while the others were booted with software to support color screens. This booting process resulted in computers on either side of one computer having identical screen displays which were different from the middle computer. If only one computer was available, or a child was assigned to a specific computer, such situations were not recorded as a screen choice. If two or more computers of different screen formats were available, children then had a choice and it was appropriately recorded.

Kindergarten students at this ECEC begin to utilize the Writing Lab in January each year. Children are either assigned to or given the opportunity to choose from the eight learning centers contained in the writing lab. These eight centers are:

Computer Center (CAI phonetics software)
Work Journal (workbook following CAI software)
Science Center
Book Center
Word Processing Center
Writing Center
Games Center
Listening Post Center

Students have the opportunity to be active in the writing lab throughout the calendar year. During the year, most students advance to First Grade beginning in September.

All kindergarten, and later during the calendar year, first grade classes visit the Writing Lab daily. Grade level classes follow a predetermined schedule and visit the Lab each day at the same time for approximately one hour. The schedule is generally determined by teacher preference and other building schedules (e.g., Music, P.E., and Library).

RESEARCH SUBJECTS

Subjects for the formal component to this study were kindergarten students attending this Early Childhood Education Center. Approximately 57% of the school's enrollment is composed of minority children. Majority and minority children represent all socio-economic levels. The diversity of the school's population provided the flexibility to select students from various ability levels, gender, socio-economic, and racial backgrounds.

In selecting subjects for the preliminary investigation, it was attempted to have all gender, racial, socio-economic,

and ability groups represented, reflecting the school's diversity. These subject characteristics were shared with teachers who were requested to suggest subjects. There were three levels of academic ability: high, those who were already reading and writing; middle, those who knew the majority of the alphabet and some sounds; and low, those who knew few letters or sounds. Of the six subjects, there was an equal balance between gender and race. Two levels of socio-economic status were represented, determined through free lunch eligibility. These same procedures were followed in selecting six subjects for the formal data collection period.

DATA COLLECTION

Throughout this study the researcher attempted to collect data focused on the process of budding literates using the word processor as a writing tool. Collected data in rough form consisted of anecdotal observations, copies of subject products, and colleague comments. Yin (1984) writes:

Observational evidence is often useful in providing additional information about the topic being studied. If a case study is about a new technology, for instance, observations of the technology at work are invaluable aids to any further understanding of the limits or problems with the technology (p. 85).

Teal, Hiebert, and Chittenden (1987) write: "For assessing early literacy, performance sample methods, along with observation, pose a promising approach" (p. 773).

This research study incorporates extensive observation and data collection periods. Guba and Lincoln (1981) share:

Thus, credibility is to some extent a function of the amount of time and effort that the naturalistic inquirer invests in repeated and continuous observation. The investigator who engages in persistent observation and makes extended contacts not only will be able to differentiate typical from atypical situations or identify the enduring or pervasive qualities that characterize a situation but will also know when to give credence to the occasional aberrant or apparently idiosyncratic observation that nevertheless carries great insight and meaning (p. 109).

Daily observations occurred incorporating anecdotal recordings, samples of student writing, and behavior checklist forms. Fetterman (1980) writes: "Specific patterns of behavior emerge from repeated viewings based on and placed in perspective by previous long-term observations" (p. 45). Throughout the study period, student products were analyzed in association with this study's original questions. All of the collected material has been used during and after the proposed period of research for evaluation and analysis of children's interactions and use of word processing in association with their print literacy development.

The researcher attempted to be in the Writing Lab on a daily basis while subjects were there. As children used a word processor, he endeavored to record the behaviors he

observed through anecdotal recordings and/or a behavior checklist which evolved during the preliminary research (Appendix A). Anecdotal recording was accomplished, through note taking with pencil and paper and/or word processor, at the research site. Some days the researcher used one of the PCs to write anecdotal observations. Following each subjects' use of a word processor, the researcher saved a copy of their product on a computer disk as well as printed a hard copy of their text and stapled it to his notes. At the conclusion of each session in the lab with the class, the researcher codified on charts the subject's behaviors and processes he had observed and wrote a summary note of the day's observations and subjects' products.

The formal data collection period of this study commenced during January 1987. In addition to the extensive data collection and analysis, the researcher continued his dialogue with colleagues. Teachers, aides, and parents have shared their insights, knowledge, and understandings associated with these young students and the writing process. This has continued since the early preliminary research during the Fall of 1985. The researcher has found these conversations to be most enlightening, insightful, and helpful. Their insights and thoughts have helped the researcher to better understand childrens' behaviors as well as specific incidents.

DATA COLLECTION INSTRUMENTATION

Beginning with the preliminary research, the researcher continued to adapt and add to his instrumentation. This has not only included field note collection, but also the daily recording of behaviors associated with this study's questions. Prior to the start of the formal data collection period, the researcher created computer data bases and spread sheets in order to store and refine collected data. Levin (1985) writes about the use of computers in storage and retrieval of qualitative data:

...computerized data storage and search. ... is still in its infancy within anthropology and other social science disciplines, but is almost certain to become of increasing importance in the years to come ... (p. 171).

The researcher anticipated that as he used recording instruments, collected, stored, and refined data, he would find more effective and efficient methods.

The following figures illustrate instruments which can be found in their entirety in Appendices A and B.

Monthly Report

This report form was used to record each day a subject was observed. The weekly checklist illustrated in Figure 3.5, is replicated on the actual Monthly Report form five times. Week dates are recorded within the observation month. This completed report provides information at a glance as to

frequency of individual subject observations and apparent patterns of recorded observations.

Monthly Report Month _____

Check days children observed:

Children	Monday	Tuesday	Wednesday	Thursday	Friday
Week of _____					
Martha					
Christy					
Dave					
Robert					
Rachel					
Mark					

Figure 3.5 Sample section of Monthly Report form.

Daily Case Study Group Data Collection

This document, partially illustrated in Figure 3.6, was used to record the movement of each subject in and out of the word processor learning center. As illustrated in Appendix A, this recording instrument was used to record a five day week. On this document was recorded the word processor used (WP used), monochrome or color screen (Choice), if the selection was a choice, and the beginning and ending times as well as total time (B T, E T, and T T). Room was provided in the activity column to record the primary behaviors observed while the comments column allowed space for recording additional data.

Daily Case Study Group Data Collection Week of _____

Day	WP used	Choice	B T	E T	T T	Activity	Comments
Subject							

Figure 3.6 Sample section of Daily Case Study Group Data Collection form.

Daily Case Study Data Collection Form

This form, illustrated in Figure 3.7, was used to collect daily observational data. It was individualized for each subject. Certain data from this form were transferred to other refining instruments. This form was also used to record developmental literacy behaviors which were then transferred in a refined or indexed manner to another form. In the line "WP Used Blue 1 2 3...", the words and numbers represent specific computers. The corresponding color word and number were circled as children selected a computer and began their word processing. The term choice was circled if children actually had a choice between at least two computers; otherwise, it was crossed out. The no-choice could be due either to only one available computer or teacher direction to a specific location.

Name: _____ Date: _____ Time: B _____ E _____
 Daily Case Study Data Collection Form
 WP Used: Blue 1 2 3 Green 1 2 3 Color B & W
 Choice
 ___ Right ___ Left ___ Both ___ Mix
 ___ Banger ___ Moderate ___ Easy ___ Mix
 Ability to find keys: ___ Hard ___ Moderate ___ Easy ___ Play Typing
 Keyboard Location: ___ Table ___ Lap ___ Other
 Touching: ___ keyboard ___ screen ___ paper
 Body Position: ___ sitting ___ standing ___ sitting/standing

5 Min.	Behavior	Comments
1		

 Publishing: _____
 # of copies Shared with (list) _____
 Printing: by self by peer with peer by adult with adult
 Teacher Comments: _____

Figure 3.7 Sample of Daily Case Study Data Collection Form.

The initial data recording section of this form is followed by 6 sections of 5 minute intervals. These interval sections have two columns: one is for recording observed behaviors and the other for relevant comments in relationship to the observed behaviors. Dividing the recording section into timed intervals provides an opportunity to look for patterns within specific recording sessions. During the session, comments of any teacher or other adult were recorded at the bottom of the form.

A final act in using a word processor is to print the text file one has created. At the bottom of this form is a section for recording the print of text files by students. Space is provided for recording who does the printing and for whom hard copies are printed. There data were then transferred to another form.

Literacy Development Chart

Data from the "Daily Case Study Data Collection Form" were indexed and recorded on the "Literacy Development Chart," illustrated in Figure 3.8. This form is also individualized for subjects. The section titled "Month or s" refers to which months this form covered. Potentially, this form had space for more than one month of recorded data. During the study, it never became necessary to begin a new Literacy Development Chart. The section titled COPY refers to students copying the indexed items whereas the section WRITE refers to those items initiated by students themselves.

Student's Name _____										Month or s _____									
Literacy Development Chart																			
COPY										Write									
Date	Ply	Xp	Int	Nam	Alf	#	Wrd	Phr	Snt	Str	Nam	Alf	#	Wrd	Phr	Snt	Str	Com	

Figure 3.8 Sample of Literacy Development Chart form.

Through the preliminary research, the researcher observed these behaviors often with various children. In this form, the researcher anticipated the opportunity to observe patterns being revealed. The researcher intended to take there individual subject data and reconfigure them into graph form. From such statistical forms, the researcher could then compare graphs from all subjects and look for commonalities.

The following is a list of the form's headings and what they represent.

Ply - play
 Xpl - explore
 Imt - imitate
 Nam - name
 Alf - alphabet
 # - number
 Wrđ - word
 Phr - phrase
 Snt - sentence
 Str - story

The researcher also recorded this information on a data base illustrated in Figure 3.9.

File: Sub Lit Data Page 1
 Report: sample
 Date Ply Xpl Imt Nam Alph # Wrđ Phrs Snt Stry Nam Alph # Wrđ Phrs Snt Stry

 Operational Definitions of Indexed Terms:
 Ply - play -- no apparent purpose in mind (ie. simply running fingers over keys, nonsense material produced)
 Xpl - explore -- keyboard behaviors appear to be constructive in nature (ie. appears to try out specific keyboard function)
 Imt - imitate -- copies on keyboard what s/he sees another person do (ie. imitate someone typing)
 Nam - name -- copies or writes part of or all of own name
 Alf - alphabet -- copies or writes part of or whole alphabet
 # - number -- copies or writes numbers
 Wrđ - word -- copies or writes a word or words
 Phr - phrase -- copies or writes a phrase of multiple words
 Snt - sentence -- copies or writes one or more sentences
 Str - story -- copies or writes a story with a beginning, middle and end

Figure 3.9 Sample of individual subject writing behaviors data base and explanation of terms.

Publishing Chart

The manner in which text files were printed was recorded on the "Daily Case Study Data Collection Form." This information was transferred to the individualized Publishing Chart, illustrated in Figure 3.10. Recording this behavior in chart form, as a visual, provided an opportunity to reveal a pattern if one existed.

Name _____						Month or s _____	
Publishing Chart							
BY			WITH			#	Shared With
Date	self	peer	adult	peer	adult		

Figure 3.10 Sample of Publishing Chart data collection form.

Data Collection Outline

Throughout the January to June case study period it was the researcher's intention to adhere to the following schedule.

- Daily Activities: 15-60 minutes
 - Observe at least one of the six case study students in the Writing Lab using a word processor.
 - File a summary report of the day's observations.
- Weekly Activities:
 - Transfer collected data from daily collection forms to the study's data bases.

DATA ANALYSIS

It is an assumed characteristic of qualitative research that data analysis is a continuous process throughout the life of a research project. Analysis of what is occurring at the field site and collected data will assist one in the evolution of a qualitative study. Miles and Huberman (1984) write:

Analysis during data collection lets the fieldworker cycle back and forth between thinking about the existing data and generating strategies for collecting existing data and generating strategies for collecting new--often better quality--data; it can be a healthy corrective for built-in blind spots; and it makes analysis an ongoing, lively enterprise that is linked to the energizing effects of fieldwork. ... So the ideal model for data collection and analysis is one that interweaves them from the beginning (p. 49).

This study reflects the position Miles and Huberman (1984) express above. As the observational data collected, there were summary reports prepared daily which forced the

researcher to reflect upon what he had observed that day. The collected data were reviewed and analyzed daily and weekly as the researcher attempted to detect individual and group patterns, processes, and behaviors prior to the end of the formal data collection period.

As the researcher observed student involvement with word processing, using the "Daily Case Study Data Collection Form" (Figure 3.7), he immediately wrote key descriptive words and then an anecdotal type description of the behavior. Following the formal data collection period he used this key word data to develop a matrix of observed general behaviors. Miles and Huberman (1984) write: "A checklist matrix is a format for analyzing field data that can be combined into a summative index or scale" (p. 95). Once the matrix was completed, he was able to compare subject's behaviors with the matrix and look for patterns and processes. This and other collected data have also been analyzed quantitatively. Again, Miles and Huberman (1984):

... a checklist format itself does a good deal to make data collection more systematic, enable verification, encourage comparability, and permit simple quantification where that is appropriate (p. 99).

Such data analysis procedures can be used for a variety of variables.

Data from issues such as "Length of time at word processor" and "Software screen color" were quantified statistically. It was anticipated that it would be possible

to calculate the mean, median, and standard deviation for the issue "Length of time with the word processor" and that such statistics would be meaningful. It was also possible to determine and then statistically manipulate the selected frequency of "Software screen color." Both of these issues had the potential to be analyzed monthly as well as in the long term, over the period of data collection.

The majority of behaviors associated with this research can best be analyzed qualitatively. As expressed above, there has been a continuous re-focusing and re-drawing of the study's framework. Throughout the study period and following it, the researcher attempted to refine and reduce collected data to a more manageable dimension. Miles and Huberman (1984) share:

Outlines, reporting formats, and displays are all data-reductive devices for getting hundreds of pages of text down to workable units--three to four pages of text and some summarizing tables or figures (p. 152).

RESEARCH TIME LINE

Figure 3.3 illustrates the research time line of this study. The formal data collection period began in January 1987. The researcher continued to collect data to the end of the subjects' kindergarten contact with the word processing center in the Writing Lab, June 1987. Data analysis began with the first day he wrote a summary report and continued

through the data collection period and into the final chapters of this dissertation.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

INTRODUCTION

Scenario

I am gunnoo be a morshin
in 30.

It was the first of October in the United States and Andrew, age 6, had been thinking about his subject for the past few days. Although he may have been thinking about this subject for several weeks, he had been working on this particular text for only a few minutes. As one can see, he knows many English letter sound conventions. This is even evident in his inventive spellings of "gunnoo" and "morshin."

Now, Andy and his buddy Scott stood before the computer monitor thoughtfully eyeing the sentence. After a moment, Andy turned to Scott and said "No, I don't mean the number 30, I want the word thirty." Andy quickly made two backspace key strokes resulting in the erasure of the numeral 30, and then waited. Scott looked at Andy, then at the computer screen, and a moment later slowly began to type. By the time Scott finished writing the word "thrt," Andy was ready to continue writing and quickly followed with the word "days" and a period. Familiar with writing his entire name, Andrew proceeded to talk himself through all its letters. His sentence now read:

I am gunno be a morshin
in thrt days. Andrew Peter
McDonald-Miller

All of this was written across the top line of the word processing screen. Next, at Andy's request, Scott added the date to his story. Andy asked Scott to write the date, "... because you can write it faster than me." As Scott began to write the word October, Andy told him that he could write the date in numbers. When finished, Scott backspaced a few times, erasing part of the date and telling Andrew that the numbers were too far apart. Scott then rewrote the date's numerals as Andy talked to him about using a different punctuation mark to separate the numbers.

Though it was Andrew's idea, both boys were involved in this pre-Halloween story. Andy had begun with his thought of writing about his Halloween costume plans. Although it was still thirty days away, Andy was planning on being a Martian. His friend Scott, initially looking over his shoulder and reading the computer screen, now knew all about Andy's plans.

A few moments earlier, Scott, Andy's long time buddy, had walked by the word processing center and stopped to chat. Since then, there had been continual chatter and sharing of ideas between the boys. Their discussion included the idea that a number could be written in both numeral and word form. Andy appreciated Scott's writing the numeral 30 but was quick to tell his buddy that he wanted the "... word thirty, not the number 30." Both boys re-read Andrew's text. Then Scott wrote the word "thrt" using his understanding of English letter-sound conventions. Scott and Andy continued to think about, discuss and share ideas as they collaborated on the date. Once completed, Andrew's text appeared as follows:

I am gunno be a morshin
in thrt days. Andrew Peter
McDonald-Miller
October 1, 1986

Explanation

Conversations, similar to the above scenario, were observed to be a regular part of the word processor environment while conducting this research. In this scenario, the publicness of computer technology was demonstrated as Scott read over Andrew's shoulder. In addition, both boys exhibited a sense of collaboration as they worked together and discussed certain print literacy conventions such as the proper spacing between the date's numerals. Their conversation, sharing behaviors, and actions also illustrate the ease with which one can manipulate this tool. After Andy erased the numeral 30, he turned to Scott and requested the "WORD" thirty. These behaviors and actions

are but a sample of those revealed as I refined and analyzed data collected during this investigation.

This scenario was recorded on video tape during my preliminary research, nine months and a summer vacation after Scott and Andrew began to use a word processor in Kindergarten. Scott entered school as what educators typically refer to as a "reader," while Andrew was considered a "non-reader." Part of the story of how these two boys evolved to possess the abilities they exhibit in this scenario can be understood through the presentation and analysis of data collected during my formal research of five subjects.

Following this scenario, Chapter IV contains a section which delineates the period of data collection. Next, a restatement of the study questions is followed by the findings. These findings are separated into four sections. The first section presents quantitative data related to questions 1 and 1a. This is followed by qualitative data, and a description of its analysis, as it relates to questions 1 and 1a. The third section presents data associated with questions 1b and 2. Additional findings are presented in the final section.

Data Collection

The data collection period of the formal research component to this study covered five months. Displayed in

Table I are a variety of time forms representing this time span. Consisting of attempts at daily observations, this time span extended over a 20 week period. Due to holidays, school programs and other job-related responsibilities, observations occurred every four of five school days. During the five months, the actual number of observational days was 80. Daily observational periods lasted an hour, from 10 to 11 in the morning. These hourly sessions were followed by one half hour of data transfer activities and writing entries into the journals listed in Table I. Total number of observation hours was 80.

During these 80 hours of observation, I employed the various recording forms previously illustrated and explained in Chapter III. In addition to recording behaviors on the "Daily Case Study Data Collection Form," displayed in Figure 3.7, concomitant anecdotal recordings of students' behaviors were completed. The minimum use of the "Daily Case Study Data Collection Form" was once per observation hour. However, if an observed subject's involvement with the word processor learning center was less than 20 minutes, it was possible to observe another subject that same hour using this same recording form. If it was not possible to record more than one subject in a hour with the "Daily Case Study Data Collection Form," the other subjects' word processor involvement was always recorded on the "Daily Case Study Group Data Collection Form," displayed in Figure 3.6.

Subjects' written documents were always saved, both on a file disk and a printed hard copy. This occurred whether or not a subject had been observed that day using the "Daily Case Study Data Collection Form."

Following each observational session, committed time, use of printer, and choice of computer data were immediately transferred to data analyzing forms. Examples of these analyzing instruments are contained in Appendix B. At the end of each week, all recorded items from the various collection forms were transferred to corresponding computer data bases. After a few weeks of inputting data and upon examination of these data bases, certain patterns and trends began to appear. Following the data collection period, additional data bases were created as the collected data were analyzed. Further explanation concerning the collapsing and analyzing of qualitative data is contained in the section titled: "Qualitative Research Analysis of Questions." Presentation and clarification of these patterns and trends and analysis of the data follow.

TABLE I
DURATION OF DATA COLLECTION PERIOD AND
DISK MEMORY STORAGE FOR
ANECDOTAL JOURNALS

<u>TIME RANGE</u>	
5 Months, 20 Weeks, 80 Days, 80 Hours	
<u>COMPUTER MEMORY STORAGE</u>	
Martha Journal	19 K
Christy Journal	18 K
Dave Journal	29 K
Malcom Journal	6 K
(moved out of neighborhood)	
Rachel Journal	12 K
Mark Journal	15 K
General Journal	35 K

Seven journals were created for this study, one for each subject plus a "General Journal." These were employed for recording anecdotes following each observational period. These entries were generally elaborations of collected data and the investigator's perceived insights about subjects' behaviors. "General Journal" entries included observations of phenomenon of interest not included elsewhere. These anecdotal entries often included incidents involving non-subject students.

In light of the data collection period extending over 5 months, as displayed in Table I, two of these journals became lengthy. Since one subject was lost to the study during the second month, (his family moved out of the school's neighborhood) only six journals had entries covering the entire data collection period. These six journals took up 128K (131,072) bytes of memory space, almost all the

allowable memory on a 5 1/4 inch floppy disk. (Each K represents 1,024 bytes or characters of memory space.) This is approximately 32 typed single space pages. The memory size of these journals ranged from the 35K of the "General Journal" to the 12K in the "Rachel Journal." All of this anecdotal journal data was in addition to the extensive amount of data collected during the 80 hour-long observation periods.

Scholars studying childrens' writing behaviors and associated tools of the Industrial Age (e.g. pencils, pens, and crayons) have employed certain terms to describe childrens' specific behaviors associated with these tools. Clay (1975), Graves (1983), and others refer to childrens' early use of a pencil or other writing implement as scribbling (Atkins, 1984; Baghban, 1984; Bissex, 1980). This behavior of scribbling carries the connotation of play and exploration. The computer, primary tool of the Information Age, does not possess inherent possibilities for scribbling. However, computer systems possess the potential for play and exploration. Throughout this study, play and exploration behaviors associated with a computer are termed "Gobbledygook." In this study, other terms used to describe more sophisticated writing behaviors correspond to those employed by scholars and researchers studying childrens' written language behaviors associated with Industrial Age writing tools, i.e. "copying" and "writing."

During this study it was found that children often employed language and technology behaviors other than those directly associated with writing. A term employed throughout this study to describe these behaviors is "Dilly-Dallying." As explained later in this chapter, many language and technology behaviors were grouped into a category termed "Dilly-Dallying."

During the process of analysis, all data were read many times and color coded according to specific behavior categories. Throughout these processes of recording and analyzing data, the research focus was always that of the Study Statement.

STUDY STATEMENT

If given the opportunity, how will children use word processing in their print literacy development during their Kindergarten experience?

Questions

1. What developmental sequences related to print literacy reveal themselves as kindergarten children use a word processor?
 - 1a. In what ways are these sequences the same as or different from those identified by researchers studying young children's use of pencil and paper?

- 1b. What type of time commitments do children make at each stage of these developmental sequences?
2. How do the physical attributes of the computer environment influence children's behavior associated with word processing? For example: screen color or computer location.

PRESENTATION AND ANALYSIS OF DATA

Question - 1

What developmental sequences related to print literacy reveal themselves as kindergarten children use a word processor?

I found the children associated with this research to exhibit print literacy behaviors. When data was analyzed and placed in specific categories, certain patterns or sequences emerge, but not clear developmental stages. The evolving print literacy behaviors exhibited by students during this research are represented in Figure 4.1.

Gobbledygook
 Play
 Explore

Copying
 Name
 Alphabet, numbers
 Words, groups of words

Writing
 Name
 Words
 Phrases
 Sentences
 Stories, letters

Figure 4.1 Behavioral sequences of print literacy using a word processor.

There are three behavioral areas represented in Figure 4.1. The first area titled "Gobbledygook" refers to the play and exploration behaviors often observed as children used a word processor. At times it was obvious that children were playing as they wrote a batch of letters, numbers, or other keyboard signs. There were other occasions of exploration when a child would first write a word in capitals and then repeat it in lower case letters. There were many times when play and exploration were indistinguishable, e.g., with a friend, copying from a book and giggling over their writing the word "toilet," then trying to think of how to write similar "potty" type words.

"Copying" behavior was obvious. Copying the alphabet and the numbers 1 through 9 from a wall chart was an early "copying" behavior for many students. Others ignored the alphabet and instead copied words and short phrases from their surroundings. Children would copy letters or words from books, posters, wall charts, word card labels, or

dangling mobiles. With time, "copying" behavior products evolved into lists of words.

"Writing" behaviors were often initially observed to be a component of "copying" behaviors. Generally, the first word which children wrote was their name. This was often followed by names of family members as well as assigned words from the IBM "Writing To Read" program. Once children were able to write a few words, their next attempts were at writing sentences and stories. See Figure 4.3 and Appendix C. As I daily recorded the types of writing behaviors, they appeared to form an evolutionary progression. An example of such a progression is illustrated in Figure 4.2.

1/22/87

Martha FISH fish candycane
 gfgtrtutdfgteytdyueyewyufgfcbbhwsyfgdugjdjjvcjsfdhufhfhfhhhyuggghgjjduue
 hioi ballet
 ghuhyyfhsuuhhsueu;y;uihuuhhiieowiwitutuueh7619t
 op8opikruuhgjjusuhutjhugyghyguhuhuhghfjjfdjdrjtuijhjijihj;j;jhijothghdu
 rkulklbmcvvxxaxwxewxendl;fm;1[1t[=eddl,bknjijl;-jffjnvcnbb-bxvklmg.284-3
 105jgongjy7ucghjkkkkkkkokko7009909ijijokbbv (and more gobbledygook)

2/20/87

Martha ESHELL COMPUTER THREE ABCDEFGHIJKLMNOPQRSTUVWXYZ
 VASE BLUE RED RABBIT LEG THREE
 ENTER SHIFT ESC USA

3/16/87

KIT COMPUTER THRRR

MOON
 YARD
 FISH

Martha

3/19/87

this is a man the man is on the box the man is woch the man the
 end

4/10/87

THE RABBIT IS ON THE BOX THE RABBIT IS WOACH THE DOG THE END

4/16/87

Martha dog cat fish in box fox

5/6/87

I DOO BALAY AD I DOO TAP DAS IS FUN VARE MACH AD I DOO AROBTS

5/18/87

to my fad you will git tow cam to my houa sam tam i hop you wano kam
 to my hous iole hav one bike to Tori Martha
 translation: To my friend, you will get to come to my house some time. I
 hope you want to come to my house. I only have one bike. To Tori.
 Martha

Figure 4.2 Selected samples of Martha's writing with a word processor, January through June 1987, illustrating her print literacy development.

File: Martha Lit Data
Report: Analysis

Page 1

"Gobbledygook"

"Copying"

"Writing"

Date	1	2	3	4	5												
	Ply	Xpl	Nam	Alph	#	Wrd	Phrs	Snt	Stry	Nam	Alph	#	Wrd	Phrs	Snt	Stry	
Jan 14		x				x				x							
Jan 21										x				x			
Jan 22	x					x				x							
Jan 26	x					x				x				x			
Jan 27	x									x				x			
Feb 10						x				x				x			
Feb 12						x				x				x			
Feb 18						x				x				x			
Feb 20		x				x				x	x	x		x			
Feb 23						x				x							
Feb 24						x				x				x			
Feb 28						x				x	x			x			
Mar 3	x	x								x	x	x		x			
Mar 4		x				x				x		x		x			
Mar 10															x	x	
Mar 16	x	x				x				x				x			
Mar 18										x					x	x	
Mar 19														x	x		x
Mar 30	x													x	x		x
Apr 2																	x
Apr 8																	x
Apr 10	x																x
Apr 16										x					x		
Apr 21	x					x								x	x		x
Apr 28																	x
Apr 28									x								
Apr 29																	x
Apr 30																	x
May 6	x																x
May 12																	x
May 18																	x
May 19		x															
May 21		x															
May 26	x	x															
May 27	x																x
Jun 2									x								

Figure 4.3 Data base of Martha's Literacy Development Chart showing her print literacy growth during the study.

Generally, these behaviors were observed to be intertwined as children progressed along their print literacy continuums. As illustrated in Figure 4.3, Martha initially copied words and wrote her name and words while exploring and playing with text and tool. Within the first two months of my research, I observed Martha evolve to the point of writing stories. Martha's development is a continual cycling through

gobbledygook, copying, and writing. Although she became more sophisticated in her print literacy behaviors, Martha often returned to playing and exploring. Examine Figure 4.2, Martha's text for 4/16/87. Even though she is capable of writing a phrase or story, she chose that Thursday to simply write words. Similar continuous cycling can be seen in other subject's literacy development data bases (Appendix C) and in Table II.

Table II is a composite chart representing collapsed data from the subjects' literacy development data bases exhibited in Appendix C. The top of Figure 4.3, Martha's "Lit Data", displays the number code for collapsing data from subjects' literacy data bases to create Table II. The key at the bottom of Table II shows that any play or exploration behaviors are collapsed together and represented by number 1. Copying behaviors are represented by two numbers, 2 for copy behaviors; name, number, alphabet, and words, 3 for copy behaviors; phrase, sentence, and story. Writing behaviors are also represented by two numbers, 4 for writing behaviors; name, number, alphabet, and words, 5 for writing behaviors; phrase, sentence, and story. The column labeled week refers to a specific week of the study and can be correlated to the study calendar, Appendix L. In reference to subject columns, numbers in a chart cell represent those behaviors exhibited by an individual subject during that specific week.

Table II displays this continuous cycling of print literacy behaviors. Analysis of Martha's column, specifically weeks 10 and beyond, displays her movement among a combination of behaviors. By the 10th week, she has achieved the sophistication of story writing, but continues to delve into earlier print literacy behaviors. Even though she has the ability to write stories, she continues to explore and play with written language. Dave's and Mark's columns illustrate the most prominent examples of this continuous cycling movement from mature to immature and back to mature print literacy behaviors. Both boys develop written language sophistication, achieving story writing skills, but continue to play and explore written language. As with Martha, although their print literacy continues to mature, both Dave and Mark exhibit a tendency to cycle back to less sophisticated literacy activities after week 10.

TABLE II
INDIVIDUAL LITERACY DEVELOPMENT CHARTS DATA
COLLAPSED INTO FIVE CATEGORIES*

Week	Martha	Christy	Dave	Rachel	Mark
January					
1	12 4	1	12 4	2 4	12 4
2	12 4	12 4	1 4	2 4	1
3	12 4	12 4	12 4		2 4
February					
4			12 4	2 4	1
5	2 4	12 4	2 4	2 4	12 4
6	12 4	12 4	2 4	2 4	2 4
7	2 4	2 4	2 4	2 4	2 4
March					
8	12 4		2 4	2 4	
9	5c	12 4	5c	2 4	2 4
10	12 45	12 4	12 4	2 4	12 4
April					
11	1 5	2 4	12 5	2 45a,b	2 45a
12	1 5	12 4	5	34	45a
13	45	12 4		5	1 5a
14	12 5	12 4	5		2 5a
May					
15	3 5	12 45a	5	45	
16	1 5	5a	12 45		1 5a
17	5		1 4	5	2 4
18	1	5a	1	45	12
19	1 5		12 4		12 4
20 June	3		1 3	2 45	1 34
*1 - play & explore 2 - copying, name, number, alphabet, words 3 - copying, phrase, sentence, story 4 - writing, name, number, alphabet, words 5 - writing, phrase, sentence, story					
a - with adult b - with peer c - wrote letter to friend					

Also illustrated in Table II are what appear to be individual subject episodes of print literacy evolution. The collapsed data displayed in each subject's column depict subjects' individual trends in their print literacy

development. For example, Martha's literacy development chart, Figure 4.3, Appendix C, and the Martha column in Table II, illustrate that within weeks 8 to 10 she exhibited a more sophisticated use and understanding of print literacy when she began to write stories. Data displayed in Table II illustrate similar individual subject episodes of print literacy growth for other subjects, but at different time periods. Of particular interest is the apparent difference in growth patterns among subjects. While all subjects moved toward a more mature understanding of print literacy, they did it in different sequences. Another observed difference is that two of the subjects appear to have four individual subject episodes of print literacy evolution during this period of study while three subjects possess only two. Dave and Mark, the oldest subjects in the study, are the two with four natural print literacy episodes.

Figure 4.4 displays a variety of skills and behaviors termed "Dilly-Dallying" which were commonly exhibited by subjects in the word processor learning center. These skills and behaviors were often observed in conjunction with writing and using a word processor.

Speaking
 Listening
 Reading
 Letters & Numbers
 Control Keys, i.e., shift key, return, caps lock
 Procedures, i.e., print, clear, save
 Formatting, i.e., displaying the text
 Sharing, i.e., exchange of information, print and tech.

Figure 4.4 "Dilly-Dallying" - examples of skills, behaviors, and understandings of print literacy and literacy of technology.

Children functionally employed these skills as they progressed along their literacy continuums. While writing, children were often observed to reread what they had written or read what they were copying. Many times, children would speak to themselves, breaking words into phonetic components attempting to determine which letter or letters corresponded to which sound. (The writing lab contained three IBM PCJrs. booted with CAI phonetics software which all students worked with each week. See Chapter III for description of WTR setting.) Students also requested assistance from peers and adults, listening to explanations and becoming involved in further discussion as they worked with sounds, letters, and words. The following entry is taken from my "Rachel Journal" notes.

3/30/87 Monday

It was interesting to observe Rachel today. She copied the cycle words [IBM Writing To Read words] with the assistance of Tori standing there telling Rachel the letters. I think she must have chatted a little more with Tori[,] as Tori sat down[,] about what should she do next. Anyway, the idea of a sentence came up and Tori told her she would help her figure out how to do it. Tori asked for a minute (to think about what to write) which she said wasn't really very long and then suddenly said I've got it. Tori then told Rachel the sentence which Rachel then wrote as Tori told her what to write and how to spell the words. Once finished,

Tori went over to Brenda [Classroom teacher] and told her that Rachel had written a sentence. Brenda really reinforced this and told her how good it was of her to write a sentence instead of her usual "emma and Rachel." Rachel then went ahead and copied a couple of wall and hanging words and then added cat. She next asked Tori which WP she was at and worked out that she was at number one. She then printed it herself.

In addition to the intertwining of print literacy behaviors, literacy of technology skills were intertwined with subjects' print literacy maturation. Early in this study it became obvious that literacy of technology associated with the print literacy tool (the word processor), was important to the print literacy process. In order for children's writing skills to progress, they require a functional awareness or understanding of the technology they are using. As with pencil, pen, and paper, it is an evolving prerequisite that children know how to manipulate their print literacy tool. An example of a child's literacy of technology skill awareness or understanding is use of space. I observed that before children could write an intelligible word or two in a conventional sense with a word processor, they had to understand where to put spaces as well as how to control the tool in order to place spaces in desired locations.

Question - 1a

In what ways are these sequences the same as or different from those identified by researchers studying young children's use of pencil and paper?

Although I conducted an extensive review of "early" literacy and writing literature, as explained in Chapter II, a universal chart displaying children's typical developmental sequence of writing behaviors was not found. Many of the bibliographic citations associated with this literature review included discussion related to children's writing development. Figure 4.5 contains a modified version of Figure 2.2 which is a composite based upon this literature review and what appears to be the developmental and evolutionary sequence or process of children's writing behaviors when using traditional literacy tools.

1. Scribbles
2. Scribbles & Pictures
3. Copy
(name, alphabet, numbers, words)
4. Name
(write own name)
5. Word
(inventive recognizable word)
initially without vowels
later with vowels
6. Word Group
(two or more word phrase)
7. Sentence
(a simple sentence)
8. Story
(two or more sentences)
9. Punctuated Story
(story with appropriate punctuation)
10. Paragraphed Story
(story with more than one theme)

Figure 4.5 Writing behaviors of children. A composite of various authorities and my interpretation of behaviors associated with the evolution of people's writing in a print laden-society.

Figure 4.6 is a composite of modified Figures 4.1 and 4.5. This Figure displays written language development for both the pen or pencil and paper system and the word processor system. Whereas the pen or pencil and paper system represents ten components, the word processor system represents three components. The lines in the middle of Figure 4.6 illustrate the relationship of writing with the pen or pencil and paper system and the word processor system.

Figure 4.5 Pen or Pencil & Paper System		Figure 4.1 Word Processor System
1. Scribbles	\	
2. Scribbles & Pictures	/	Gobbledygook (play, explore)
3. Copy	-	Copying (name, alphabet, numbers, words, groups of words)
4. Name	\	
5. Word	\	
6. Word Group	\	
7. Sentence	-	Writing (name, words, phrases, sentences, stories, letters)
8. Story	/	
9. Punctuated Story	/	
10. Paragraphed Story	/	

Figure 4.6 Development of writing in children. Composite of Figures 4.1 and 4.5 displaying the interrelationship between the original systems.

It would have been possible to prepare Figure 4.1 in a linear fashion similar to that of Figure 4.5. However, as previously stated, there is an intertwined evolution between the tool and print literacy. Although subjects exhibited steady growth towards a more sophisticated literacy, this growth included constant "Dilly-Dallying" and continuous

cycling back to earlier print literacy and literacy of technology skills and behaviors as illustrated in Table II. An example of this occurred two days before I recorded Martha writing her first story and the week after she had written a letter. My "Martha Journal" entry follows and Martha's corresponding text dated March 16 appears in Figure 4.7.

3/16/87 Monday

Martha got into some exploration today with her moving her name around the screen by putting the cursor back at the beginning [of her document] using the arrow keys. This turned into play as she continued to mess with the word and her movement [of it] about the screen. After writing the word moon the same thing happened.

Also of interest, she was writing with lower case and then switched to upper case. She did this as she was copying one of the cycle words. She tried it first with upper case and then erased it. She next did it with lower case letters and then erased that. She finally settled with upper case and put the caps lock on.

The order on the screen is not the way she wrote. She began with her name, then went to yard and moon. She next went to the beginning [of her document] and wrote ["]kit["] and ["]computer thrrr["] [moving everything to the right and down the screen]. She then finished with [wrote "]fish["] and ["]esc["] which the ["]esc["] she erased. [After copying the keyboard symbol "esc," she erased it.]

3/16/87
KIT COMPUTER THRRR

MOON
YARD Martha
FISH

Figure 4.7 Martha's word processor written product for March 16, 1987.

This journal entry and Figure 4.7 illustrate that Martha appeared to discover that she could easily manipulate text on her word processor screen and began to explore a variety of

possibilities. After writing her name and returning the cursor to the beginning of her document, Martha began to play with her writing space by moving her name about the word processor screen. She wrote additional words which she also moved about her text screen. Martha's play with words included her decision concerning which type of letters to use, upper or lower case. The ease of erasing a word or words is displayed here when Martha clears "esc" just after writing it. She accomplished all of this textual manipulation and printed her document within ten minutes. Although Martha could have created a similar product using paper and pen or pencil, it would not have been done as quickly or cleanly. Also, using paper and pencil, she would not have the control to move text about the paper and easily change the textual format. Martha demonstrated in this ten minutes that she could write words but returned to "Gobbledygook" in order to "Dilly-Dally" with print literacy and literacy of technology.

Data displayed in Table II illustrate this constant movement between and among print literacy behaviors. Children progressed towards a mature use of print literacy and literacy of technology, but often cycled back to, and "Dilly-Dallied" in, previous less mature activities, skills, and behaviors.

QUALITATIVE RESEARCH ANALYSIS AND PRESENTATION OF QUESTIONS

Question - 1.

What developmental sequences related to print literacy reveal themselves as kindergarten children use a word processor?

Question - 1a.

In what ways are these sequences the same as or different from those identified by researchers studying young children's use of pencil and paper?

COLLAPSING, ANALYZING, AND PRESENTING

Collapsing And Analyzing

Throughout the period of this study, I observed and recorded children integrating print literacy and literacy of technology skills and behaviors in their writing as well as their social interchanges with peers and adults. These behaviors and skills were recorded on the Daily Case Study Data Collection Form, in anecdotal notes, and in my general and subject journals. Once collected, this data had to be analyzed and arranged for presentation. In relation to qualitative data, Miles and Huberman (1984) offer this guidance:

1. We consider that analysis consists of three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification (p. 21).

2. Despite all this, we argue several times in this book that although words may be more unwieldy than numbers, they also enable 'thick description,' as Geertz (1973) suggests. That is, they render more meaning than numbers alone, and should be hung onto throughout data analysis (p. 54).
3. As yet there are no agreed-upon data set-ups among qualitative researchers, so each analyst has to invent his or her own (p. 79).

A recurring trend, the intertwining of print literacy and literacy of technology, continued to appear throughout this investigation. In order to conduct a closer analysis of this trend, I collapsed anecdotal notes, recorded during observations, into the following trend related categories: print, technology, mixed technologies, social, print social, and technology social. These categories are defined in Figure 4.8.

Print - a form of print literacy, "Gobbledygook," "Copying," "Writing."
 Technology - use of the tool in a manner other than just typing letters or numbers.
 Mixed Technologies - when both print and technological literacies were employed together.
 Social - those items not directly related to Print Social or Technology Social.
 Print Social - interaction related to print literacy between individuals and among groups.
 Technology Social - interaction related to literacy of technology between individuals and among groups.

Figure 4.8 Definitions of qualitatively arranged and collapsed data categories.

Talking to oneself appeared to be another important behavior as children worked with print at a word processor. This category is titled "Self Talk." Another important component titled "Date" was added to the data collapsing

arrangement. "Date" references the data, it refers to the date data was recorded.

The next step in collapsing and arranging this qualitative data was selection of four colored highlighters: one color for each of the first three categories, plus one for all social behaviors. If self talk was present, it was marked with an x. Working on one subject's collected data at a time, I read through, analyzed, and coded all of the recorded data for each observation. Following the completion of this step, a text file was created with the categories arranged as follows:

```
Date
Print:
Technology:
Mix Literacies:
Social:
Print Social:
Tech Social:
Self Talk:
      (space for comments)
```

In order to accommodate remarks, a space was put at the bottom of each dated entry.

Once these data were collapsed and arranged in a manageable form, various figures were created. Manipulating data in such a manner allows for error through subjective interpretation although as one moves through the process of analysis one attempts to be as objective and study question focused as possible. In the future, computers, with artificial intelligence, may help satisfy the concern for objectivity. One other point: a qualitative researcher may

not realize the importance of something until the research is underway or has been completed, and therefore the recorded data may be incomplete for certain issues. The following presentation is a result of the afore described qualitative research process.

Print Literacy

Table III is a composite of each subject's frequency of involvement in the types of skills and behaviors described by the qualitative research techniques. Each column is labeled and represents one of the categories defined in Figure 4.8. Illustrated in the left column "Print," and also on the individually-compiled charts displayed in Appendix D, of all the recorded and analyzed opportunities to visit the word processor center, three of the subjects had 100% print literacy participation. All subjects were well above 90%. Almost every time subjects were involved with a word processor they were doing something with print, "Gobbledygook," "Copying," or "Writing." In addition to Figure 4.2, Figure 4.9 displays examples of subject products accepted for the "print literacy" category.

1/27/87 Tuesday

dfhyyyhygvffggddfsasasawsqertuiopjh'hggffdsderrreddghjllcbvbvnmgfssasddfqw
ertyuyyggghrtuyuiiuggghcvvgjoi98terrryuoyydfghkl;l;lgffdfghjhlzcvbvnmmkk
jshsjhsgshjhsshstyugwqy17uqyuyaayyat6whsjhshjsjhsjkshjhshjsjsshkjsdlyqw
ueuiopopoproroptppltnjsjksmnmx,s,mmzsgcnbvbcbxnmnmxxjksjdsshgffsdssfgasa
ggshsjhfhjffghjhgfugyuhyjgfd,sm,xa.lsooooissisuyeue93ieoeoeikekikeim

2/9/87 Monday

PIG SUN BED Rachel IEG MAN FISH STRAW dOG LEFT

4/9/87 Thursday

Rachel i amgo to the pet shop i go to the to sdor

Figure 4.9 Examples of subjects' word processor products representing "Gobbledygook," "Copying," and "Writing."

Literacy Of Technology

Regarding the second column of Table III, "Technology," all subjects displayed involvement in technology associated behaviors above the 70% level with three above 85%. While at the word processor all subjects displayed behaviors associated with the tool, literacy of technology. A list of these behaviors includes:

- use of caps lock
- inputting spaces
- touching the screen
- attempted to determine why printer wouldn't output
- key rubbing
- play with space bar and backspace moving cursor
- play with return key
- movement of cursor, letters, or words about screen
- play type
- primitive keyboarding skills
- use of print screen keys instead of printing process
- save text
- retrieve text
- clearing text
- exploring the software, the edit mode

Martha's text dated 3/16 displayed in Figures 4.2 and 4.7 is typical of children's manipulation of the technology, their ability to move cursor and words around the screen. Subjects employed a variety of keyboard keys during their manipulating: arrow, backspace, delete, and enter. An entry in my "Christy Journal" offers another view of these behaviors.

3/12/87 Thursday

Christy was kind of exploring with the use of her space bar and backspace keys today. She had wrapped to the next line and then backspaced back to the previous line while erasing a word she was working on. Later she went on to write some more words and letters and numbers and then

backspaced and erased these items when moving the cursor back to the previous line.

Of the many technology behaviors, two incorporated the physical act of touching. At different times during the study, all subjects were observed to touch the screen. This behavior coincided with their reviewing and rereading their text, appearing to try and touch their text. Key-rubbing was the other technology touching behavior. It was noted that all subjects would rub their fingers back and forth across the keyboard at times. The following entry in my "Martha Journal" illustrates a typical journal entry recording this behavior.

4/21/87 Tuesday

Martha was assigned to come over to the WPs today and to write her cycle words and anything else she wanted to. She got started right away banging out the letters as she copied her cycle words. Lots of swinging of legs as she went through this process. She also got to the word house and stayed with it for a bit, rubbing her fingers across the keys, apparently thinking about what she was doing. At one point she pushed too hard and then had to erase.

It was common to observe subjects rub their fingers across the keys. Key-rubbing was not an isolated behavior. It was generally observed when subjects were intently involved in working on a word, a sentence, or a story; basically, at a time when they appeared deep in thought.

An additional physical phenomena of interest were subjects attempts at keyboarding. At times, subjects attempted to hold their fingers in a home-row-key fashion and try to type even though they had not been taught any

keyboarding skills. They also tried alternating their typing from one hand to another. This consisted of first finding a desired letter on one side of the keyboard and pushing the key with a finger of the corresponding hand and then moving to the other side of the keyboard to find a desired letter and pushing the key with a finger of the corresponding hand. This keyboarding process was repeated until the word was written or the child lost interest. The following comments, two journal entries based on Martha's contact with a word processor, illustrate keyboarding behaviors.

3/4/87

Also, at one point when she was first copying the cycle words she had both hands poised over the keyboard appearing to want to use them in a touch typing type manner. She was interrupted by something else and when her attention was back to the keyboard she used just her right or left hand.

5/18/87

She was pointing and touching the screen as she was reading when I arrived. She was using her right and then left hand looking for keys and talking to herself, saying the words and then also the sounds as she wrote. She constantly went back to reread her work, stopping and figuring out what she had written.

Martha's writing consisted of the talking to herself about the words she was using and the sounds in those words. Also rereading and going back over what she had already written.

Mixed Literacies

In comparison to the first two categories of Table III, the subject's percentage levels in "Mixed Literacies" illustrates less involvement. However, since it is not possible to directly observe a subject's cognitive processes, some of the behaviors attributed to the print literacy and

literacy of technology categories may also be appropriate here. The types of behaviors associated with this category include:

- play with text
- format text
- hold shift key to print capitals
- use of caps lock
- erasure of misspelled words or not appropriate word
- use of space bar and arrow keys to go to next line
- touching screen as rereading
- inappropriate, for written language, use of keys and software
- attempting to find appropriate print conventions
- rewriting words

Subjects were observed to manipulate their text in order to create specific formats which often resulted in their discovery of written English language conventions. Children commonly moved words along a text line inputting spaces of varying sizes between words. Some children wrote their texts in columns, lining words up on one line with those in the line above. Their manipulations included moving the cursor back into their document, rewriting as necessary and then returning the cursor to the end of their document and continuing to write.

At times, the mix of technologies had the potential of producing devastating results, possibly with lasting insight. The following two examples are copied from entries in my "Dave" and "General" journals which include some of the above category behaviors.

4/29/87 Wednesday

Dave had a good story going this morning. Spent a lot of time at the WP center which included getting up and

helping others with their work. He wasn't all that focused but then got back to his work quite readily. When he finished he wrote THE AN and then space barred his way to the middle of the next line and wrote ["]Dave.["] and then erased the period and added a comma and then his middle name. This was a first that I had seen this behavior and his attempt at punctuation.

Dave next went to print. Instead of printing from memory he followed the yellow card (hand written To Clear instructions) on the book stand and proceeded to erase all of his work. He looked at his screen, said "What did I do?" then followed with an "Oh Nuts!" apparently knowing exactly what he had done. He turned to me and asked if there was anything I could do if it was some place where he could have it. I explained no, that it was now cleared and that it was too bad, to think about writing it again tomorrow. His concern was that it had to be in today for the Lloyd Center [Teacher Fair] display [this weekend].

4/29/87 Wednesday

After spending 35 minutes writing a story, Dave accidentally cleared his screen instead of printing his story. The idea that he is learning as a young child that this ephemeral light source is so easy to change is interesting. This is the same kid[,] who when the plug was pulled last week and everything crashed[, had] his come back. As adults we do these [lose texts] kinds of things and it adds a lot of stress. Dave as a young child is learning that this has occurred and that this time he was in control of the situation. I would think that this will impact him cognitively and affectively as far as his understanding and relationship to the use of technology. Kind of reminds me of swimming, if you pick up the sense of control and [have no] fear of water as a child then it's easy to continue as an adult instead of trying to start as an adult.

The following entry from my "Martha Journal" illustrates her movement of text about the screen and her use of the caps lock function to explore upper and lower case alphabet letters. As is apparent in this entry, there was a great deal of mixing print literacy and literacy of technology.

3/3/87 Tuesday

The WP's were busy this morning. Just after Rachel finished, Martha came over to me as I saved Rachel's work to ask if she could use that particular WP. I told her yes and she went ahead and began to work at it.

After writing a few words, she put the cursor at the beginning of her text and then moved the words around the screen. At first this seemed to be an exploration on her point being interested in what was happening. After getting the first couple of words down to the next line it then appeared to become a playful activity. She continued to move the words further down the screen.

Next she wrote the alphabet. Initially the caps lock was on. Half way through the alphabet she took it off and began to write in lower case though once in a while she again wrote an upper case letter with the shift key.

When finished she moved the words a few lines lower on the screen and then wrote the word one. She next wrote some numerals and then erased them immediately. She then went ahead and printed her text.

This final journal entry exemplifying mixed literacies illustrates the publicness of this Information Age tool. As an author writes with a word processor, others can easily look over their shoulder and read the document. Unless an author clears the document from the screen when leaving, text remains and is available for others to read. The following example of such behavior is taken from my "Martha Journal."

4/29/87 Wednesday

Two really interesting occurrences at school. The first involved a couple of different kids as the WTR lab was clearing out and Martha was walking around the WP's getting ready to leave. She noticed one [monitor screen] and in a large excited voice yelled "Whose is that!" or "Who did that!" A couple of other kids who were still remaining in the room walked over to see what she had found. The kids had a short discussion about the work they had seen on the screen and then left to catch up with their class.

Social Behaviors

The next category represented in Table III, column "Social," incorporates those observed behaviors which did not easily fit into the other two social categories. Some of these behaviors were:

- chatting with peers about what I was doing
- telling other children what to do
- adults moving children out of word processor center
- "goof off" behaviors not related to print or technology but while at word processor center
- dialogue with others about none related topics
- adult dialogue concerning behavior
- sharing of information

There were many typical childhood behaviors occurring in the word processor center. One of note was an unwillingness by children to leave an activity where they found interest and enjoyment in order to participate in an assigned activity. This behavior was observed and documented in the word processor learning center when children were requested to stop what they were doing in order to work with CAI computers and learn written language through programmed phonics.

A refusal to comply with these directions was documented early in my "Mark Journal."

1/29/87 Thursday

Brenda asked Mark if he wanted to go to computer. He pointed to the word processors and said "Yes!" She pointed to the CAI computers and he declined.

Although this behavior was documented early during the data collection period, it was not a major concern of this study. However, there were other occurrences of similar avoidance behaviors acknowledged by other adults in the writing lab. The following entry from my "General Journal" occurred at the end of the data collection period.

6/2/87 Tuesday

Two things from this morning. One was the meta-linguistics [exhibited by the students] which occurred

over the thought of copying from a book [but not publishing it] and how to continue on [the next day] since it was time to go back to class. The other was Kathy mentioning that the kids really didn't want to go to the CAI computers and function with that software.

I think this issue of not wanting to work with the CAI software is a function of Industrial Age thinking using Information Age technology. It's learning theory of the Industrial Age being used with the literacy technology of the Information Age. She [Kathy] said the kids are bored and just not interested in the CAI type of stuff that's going on. This is with those kids who are still in the cycles at this time of the year. They aren't doing fun stuff [personally meaningful] except with the WPs and on Friday when there are games. [As the data collection period continued, Kindergarten teachers decided to use literacy games with the CAI computers on Fridays.]

This requesting children to move occurred at other times also. It commonly interfered with a variety of behaviors which is illustrated in the following entry from my "General Journal."

2/12/87 Thursday

The third activity was of particular interest. Martha and Sarah had gone to the WP's together and had sat near one another. Each began their own text file but both shared information with one another. Sarah asked Martha a couple of times where certain keys were on the keyboard. Martha would give directional answers, "On the other side (of the keyboard) somewhere." Martha said she had forgotten how to spell a couple of the cycle two words and Sarah helped her with some of these. They were both working on "bed" for Martha and coming up with various endings, none of them correct[,] when Kathy came over to tell the girls that they were next at the CAI computers. Here the girls were[,] practicing their literacy, trying out some phonemes and putting words together[,] but they had to leave their work, what they were in control of, in order to go to the CAI machines [which are] in control and learn something. Brings some questions to mind.

I intend to share today's entry with Kathy and Brenda.

Noting Table III again, Rachel is the subject with the lowest percentage of social print involvement. Rachel's personality is such that she is very quiet and unassuming.

The other children involved in this study are much more extroverted in their behaviors.

Social Behaviors Related To Print Literacy

The fourth category displayed in Table III was used to codify those behaviors which were socially associated with print literacy, column "Print Social." This category included the following behaviors.

- chatting and sharing about sounds, words, and spellings
- chatting and sharing about language conventions, e.g., punctuation, capitals,
- trying to figure out letter/sound conventions
- bragging about how much they knew
- chatting and sharing their stories and words as well as format of stories and topics
- wanting copies of other persons documents
- reading other's printed documents
- sharing text
- request adult confirmation on spellings
- meta-linguistics, solving language conventions

There were many episodes of social interchange concerning print literacy during this study. From the very beginning of the data collection period, these behaviors were commonly observed in the word processor center. Children were often involved in requesting or sharing information about language as when Sarah and Martha shared written language information with one another, recorded in my "General Journal" 2/12/87, previously noted.

Meta-linguistics was not unique to these young evolving print literates. The 3/30/87 from my "Rachel Journal" entry, a few pages back, and the following entry from my "Dave Journal"

illustrate the interest and intensity of sharing knowledge and the occurrence of meta-linguistics.

3/3/87 Tuesday

There were a number of conversations between Dave and Jason this morning. A number of them initiated by Jason as he would turn to Dave or myself and ask for the sound of a letter. Even when the question was directed to me, Dave would go ahead and answer. A couple of times this led to Dave getting out of his seat and chatting with Jason about the sounds in or actual spelling of a word. At one point he even sat down and wrote the word for him.

Except for an initial orientation session to the writing lab and its learning centers, adult-led direct group instruction was never observed. However, there were numerous daily print literate activities and associated instruction occurring within the various learning centers of the writing lab. Children continuously shared their knowledge of print and technology with their peers and writing colleagues. In addition to children discovering and reinventing written language, adults helped to facilitate the children's intellectual growth. Generally, adults responded to a child's needs or anticipated his/her next move along the print literacy and literacy of technology continuum. Often, after an adult shared a new print skill or computer operation with one child, many others were exposed to it within a few days. Children became conduits of information for their classmates. Adults and peers were facilitators for each student's literacy growth. The following entry in my "General Journal" is an example of adult and peer sharing of

an English language writing convention and illustrates meta-linguistics.

2/10/87 Tuesday

Christy spent a good 25 minutes with a WP today first doing as Brenda had requested, copying cycle words and then off playing and exploring. She did a lot of pushing keys and then erasing what she had done and then going back and pushing more keys. This wasn't done in a fast manner, but sitting there and watching [looking at the keys, monitor, and her own movements with the equipment, seeing] what she was doing [herself].

She got into a lot of words. She would play with the keys for a moment and then try to write a word. One word she knew was cat which is inbedded in her writing. She then began to think of other words which she asked various people how to spell. This included peers, Brenda and myself. As she was writing (her) paper, which she was trying to sound out with my help, Sarah noticed she hadn't left any spaces and wondered aloud to me whether she should. Sarah and I then talked about that generally when one writes that you do leave spaces. She told me that she did. Christy simply kept on with the process she had begun.

Social Behaviors Related To Literacy Of Technology

Again, in reference to Table III, column "Tech. Social," over 70% of the time children attended the word processor center they became involved in some form of social interaction associated with literacy of technology. A great amount of social interchange was in the form of assisting others or receiving assistance with the printing process. As children became self sufficient at printing and later, writing, their social interactions associated with technology moved towards sharing of information while exploring the word processor software. Many behaviors associated with this category are included in the following list.

- chatting and sharing about writing in upper and lower case letters.
- chatting and sharing about the printing process and clearing the screen
- assistance in finding keys
- chatting and sharing about manipulation of cursor
- chatting and sharing about exploring and manipulation of hardware and software
- chatting about saving or printing text
- solving printer problems

Of the many journal entries written during the data collection period which are associated with this category, two of significant interest follow. One concerns one-up-man-ship or peer squabbles. The other illustrates social etiquette of the Information Age. Both of these entries are taken from my "General Journal."

2/26/87 Thursday

An interesting situation occurred today with printing at the word processor center in the WTR (Writing Lab) room. One child went around the word processor center to turn the network switch so that she could print. As she headed back to her word processor[,] the child at the one next to the printer leaned over and turned the switch to the number for his word processor and began immediately to print. I noticed this and as I began to give my little speech about working together and asking others if the printer was free before printing, I noticed another child back at the first child's word processor erasing all of the text. I quickly walked over and after saying ["]stop["] explained that he should wait and ask the person who had been using it if they were done.

We now have children, seven weeks after getting started with WTR (Writing To Read, word processors), who are computer literate to the point that they have a lot of knowledge about manipulating a word processor and computer system. Suddenly, we are now at the point of also providing children with social skills related to the utilization of a word processor and the electronic text. Children don't generally erase other children's paper work, but with a word processor[,] it's simple.

5/7/87 Thursday

Again today[,] a lot of kids at the writing table and the WP center. Both centers were overflowing at times.

An interesting situation today. Matthew and Dave got into a fight over who knew the most about computers. These two have at times gone on a one upmanship before, but [this is] the first time it has come to blows. Both also have a little different style in their approach to the computers and exploration. With Dave it appears that he explores while involved in his writing or actual production. Matthew seems to focus right on exploring at times trying new things out with the software. Both appear to be very willing to share their findings with others.

As defined in the "Mixed Literacies" category of Table III, analysis comments related to Table II, and previous exemplified entries 2/12/87, 3/4/87, 5/18/87, and 6/2/87, many of these literacy of technology behaviors were intertwined with those of print literacy. In the setting of the word processor center, there were many opportunities for dialogue and the sharing of thoughts about print and technology.

Self Talk

The final column of Table III is labeled "Self Talk." Collecting data associated with this behavior is one of those hazy areas of qualitative research. Difficulties encountered collecting related "Self Talk" data in the word processor center were environmental noise, physically positioning myself without being too obtrusive, and not being sure if some of the subjects were speaking to themselves. In order to overcome these difficulties, I employed tape recorders during preliminary research. The resulting audio was of such poor quality that the tape recorders were abandoned. Of the subjects, Rachel was the most difficult to record since she

was so quiet. She may have spoken to herself but it was simply missed during my observations.

The category "Self Talk" is defined as speaking to oneself. This behavior was commonly observed throughout the data collection period. Initially this behavior centered on saying sounds and words as subjects developed their own print literacy skills. Eventually, this led to at least one subject reading the text from a book she was copying. The following two examples bridge this evolution in "Self Talk" behavior from sounding out words to reading a text. The first example is an entry from my "Dave Journal" while the second is an entry from my "Martha Journal."

1/20/87 Tuesday

Though I didn't follow him from the beginning of his sitting at the WP, I was able to observe Dave for a good 15 minutes or so. It's difficult to read what he has written, but there is sense to all of his words. He continued to sound out each word, erased some that he wasn't satisfied with and then went on and wrote more.

6/2/87 Tuesday

Martha came over with one of the Ladybird books and began to copy from the cover. She spoke to Hazel about the front[,] asking her what it said. She also asked me if one of the letters she was copying was an ["l"]["l"]. Once finished with the front cover she turned to the first page and began to copy from the story. She did a lot of self-talk centered on the letters and words. As she went along with this format of reading the letters[,] it evolved into reading the words. She seemed to suddenly realize that she was able to read some of the text and did so. At one point she turned to me for confirmation on one of the sentences after she had already asked for confirmation on a couple of letters and the beginning word.

In summary, writing behaviors were not isolated but intertwined with many associated print literacy and literacy

of technology skills. Also, meta-linguistics was a common practice throughout the study, commonly intertwined in the dialogue and actions of subjects. Throughout the data collection period, each subject displayed a progressive maturation towards greater print literacy and literacy of technology sophistication.

Question - 1b

What type of time commitments do children make at each stage of these developmental sequences?

Qualitative research can be described as an extremely porous medium for collecting data. With practice, experience, and contextual knowledge, a researcher's ability to collect relevant data improves. This description reflects my experience during the data collection period of this study. It was not possible to record every single incident of a subject's involvement with a word processor. In addition to interruptions, which normally occurred, there were other recording lapses, particularly at the beginning of my investigation. I found that I had to learn how my subjects operated within the word processor learning center environment. I missed observing Rachel a few times in January due to her quietness; it was as though she sneaked into the center, quietly worked, and then left without a sound so I would not be able to record her actions. An

example of my thoughts during this part of my study is included early in my "General Journal."

2/2/87 Monday

I don't know what it is, but Rachel got started without my being aware of it. She seems to sneak in and then after a few moments I notice that she is sitting there working away.

Another factor influencing the recorded time a subject spent with a word processor was that of center access. The subjects' class attended the writing lab for approximately one hour each day. In order for children to progress through the "Writing To Read" CAI cycles, the classroom teacher, Brenda, would at times have to assign children to different learning centers. As a result, even though children might want to work in the word processor center, they might not have the opportunity. The following paragraph, written early in my "General Journal," refers to this situation.

2/5/87 Thursday

Brenda has been doing a great job of directing children around the writing lab. Therefore, [because Brenda assigns them to specific learning centers other than the word processor center] they don't always get the opportunity to use or choose the word processors. At times their choice of the WP center comes at the end of the hour after they have been to the CAI computers and journal or some other centers where they haven't been for awhile. At other times they chose to go to other centers. Anyway, like today, most of the kids whom I observe were assigned to other centers or in the CAI journal rotation.

At times, I observed subjects directed to other centers when they expressed a desire to work at the word processor center. The only time I observed subjects refuse an opportunity to work with a word processor was when they had an opportunity to take their "Writing To Read" CAI mastery

test. Once they had finished the mastery test, they often requested an opportunity to return to the word processor center. Similar behaviors were observed in subjects when involved in other centers and summoned to take a CAI mastery test. Over time, I observed that the two most popular locations in the the writing lab appeared to be the writing and word processor centers. The following observation I recorded in my "General Journal."

5/5/87 Tuesday

I've noticed the past few days that we have had more kids working in the WP center than a month ago. The two big centers are the writing and the WP centers. Not as many into the chalk or books. Hazel has been spending more time in the WP center. This may have something to do with [it] or also the fact that there is a literacy maturation and it's easier for students to write now than it was a month ago.

Other than pupil absence, the only other outside variable which interfered with children's access to the Writing Lab were scheduled curriculum events. These conflicts are recorded on the school calendar. A copy of the school calendar, during the data collection period of this investigation, is included in Appendix L.

Time data presented in this section relate directly to actual subject using word processor occurrences. Writing sessions which were interrupted or interfered with by subjects being moved to another learning center or end of class period in the writing lab are excluded from this data. However, some of the writing sessions which continued for

more than 30 minutes and were terminated by the end of the class period are included.

Time Related to Natural Literacy Evolution. Among other findings, Table II illustrates what appear to be individual subject episodes of print literacy evolution. (See earlier discussion concerning Table II and associated findings.) Tables IV and V display the recorded amount of time in minutes each subject dedicated to these episodes of literacy growth. Subjects are grouped in these figures according to the number of apparent episodes of print literacy evolution.

TABLE IV

COMPILATION OF RECORDED TIME IN MINUTES RELATED TO
SUBJECT-SPECIFIC EPISODES OF PRINT LITERACY
EVOLUTION DOCUMENTED IN TABLE II
FOR Martha, Christy,
AND Rachel

Martha		Christy		Rachel		Episode
Date	Time	Date	Time	Date	Time	
1/15	11	1/13	19	1/20	5	1
1/20	6	1/20	12	1/21	8	
1/21	7	1/22	27	2/3	16	
1/23	16	1/26	20	2/5	9	
1/26	13	1/27	20	2/9	10	
2/4	9	2/10	25	2/12	18	
2/10	13	2/13	34	2/18	18	
2/12	6	2/18	23	2/26	9	
2/18	22	2/20	29	3/3	10	
2/20	24	2/26	19	3/4	10	
2/23	9	3/10	20	3/9	6	
2/24	7	3/11	18	3/12	8	
2/26	18	3/12	21	3/17	13	
3/3	8	3/16	14	3/19	10	
		3/18	12			
		3/31	13			
		4/7	11			
		4/13	10			
		4/17	16			
		4/21	12			
Total Time	169	Total Time	375	Total Time	150	2
Average	12.1	Average	18.8	Average	10.7	
Date	Time	Date	Time	Date	Time	
3/10	8	4/27	21	3/30	7	
3/16	10	4/29	12	4/1	13	
3/18	16	5/1	7	4/6	8	
3/20	12	5/5	10	4/9	12	
3/30	8	5/19	13	4/16	8	
4/2	5			4/27	8	
4/8	16			5/12	14	
4/10	5			5/22	10	
4/21	10			6/2	12	
4/28	8					
4/28	15					
4/29	10					
5/6	10					
5/12	9					
5/18	14					
5/19	10					
5/21	31					
5/27	12					
6/2	15					
Total Time	224	Total Time	63	Total Time	92	
Average	11.8	Average	12.6	Average	10.2	

TABLE V
 COMPILATION OF RECORDED TIME IN MINUTES RELATED TO
 SUBJECT-SPECIFIC EPISODES OF PRINT LITERACY
 EVOLUTION DOCUMENTED IN TABLE II
 FOR Dave AND Mark

Dave		Mark		
Date	Time	Date	Time	
1/13	19	1/12	19	Episode 1
1/14	13	1/26	22	
1/20	38	1/27	10	
1/21	13	2/2	3	
1/27	50	2/9	17	
1/29	27	2/11	13	
2/4	38			
Total Time	198	Total Time	84	
Average	28.3	Average	14	
Date	Time	Date	Time	Episode 2
2/11	25	2/17	19	
2/17	47	2/26	28	
2/23	21	3/11	19	
3/2	24	3/12	9	
3/3	49	3/19	17	
Total Time	166	Total Time	92	
Average	33.2	Average	18.4	
Date	Time	Date	Time	Episode 3
3/11	16	3/30	12	
3/17	23	4/10	15	
3/19	45	4/13	18	
3/31	12	4/16	18	
4/1	31	4/20	23	
4/8	25	4/28	11	
4/22	55	5/4	44	
4/23	57			
4/29	35			
5/5	32			
5/6	22			
5/7	14			
Total Time	367	Total Time	141	
Average	30.6	Average	20.1	
Date	Time	Date	Time	Episode 4
5/11	24	5/14	57	
5/12	14	5/18	29	
5/13	6	5/26	30	
5/18	39	6/2	26	
5/21	26	6/3	35	
5/22	31	6/4	49	
5/26	55	6/5	61	
5/27	25			
6/2	13			
6/3	37			
6/4	18			
Total Time	288	Total Time	287	
Average	26.2	Average	41	

There are some major differences in the amount of time subjects spent in their individual print literacy episodes. Numbers displayed in Table IV, illustrate Christy spending

more than twice the amount of time moving to her second print literacy episode than either Martha or Rachel. Christy's per session time involvement at the word processor center is approximately a third more than the other two girls. As illustrated in Table II, Christy moved to a more mature understanding of literacy during week 15 when she began to write stories with adult assistance. Martha and Rachel, respectively, had consummated this move 4 and 6 weeks earlier. Both Martha and Rachel were writing stories without adult assistance during their second literacy progression segment. Although Christy had spent more than twice the amount of time in her initial print literacy episode, her writing skills were not as mature as Martha's and Rachel's once she began to write stories.

Through the girls' two print literacy episodes, illustrated in Table IV, the average amount of time per session is relatively similar for each subject. The only exception to this similarity is Christy's average time commitment during her first episode. As the girls matured to a more sophisticated understanding of literacy, they spent about the same amount of time per session in each of their print literacy episodes. The exception again is Christy as her time per session decreases by about a third during her second print literacy episode. Christy did not participate in the word processor center during the final two weeks of the study as indicated in Table II.

A similar situation, illustrated in Table IV, exists when comparing Mark's and Dave's recorded involvement. Both Mark's and Dave's written literacy abilities continued to evolve throughout the period of data collection as illustrated in Table II. Through the first 16 weeks, Dave spent much more time with word processors than Mark. At each print literacy episode, Dave spent approximately twice as much total time and double the time per session as Mark. While Dave's time per session fluctuates within a range of approximately 25% through all four print literacy episodes, Mark increases his time by almost a third through his third segment and triples it during his fourth segment.

Table V illustrates that during their fourth and final print literacy episodes there was a difference of only one minute in the total amount of time that Mark and Dave dedicated to exploring, copying, and writing. However, there was a difference of 15 minutes between Dave's 26 minute average per session and Mark's 41 minutes. Dave was self sufficient in writing stories which could be interpreted as being more mature in his understanding of literacy. When Mark wrote a story, he still found it necessary to request adult or peer involvement and assistance. Even though there were these differences in time and maturation of literacy, both boys were involved in some of the same activities during their final print literacy episodes.

Monthly Time Commitment. As previously explained, it was not possible to observe and record each subject's daily involvement with the word processor. However, as displayed in Tables IV and V, except in June, during each month there were multiple observation recording sessions for each child. Figure 4.10 displays an approximation of each subject's monthly average time commitment per session. As a result of school closing for summer break, during the month of June subjects had only one week to participate in the writing center.

Figure 4.10 Graph of Subject's Average Monthly Time at Word Processor recorded in minutes. (rounded off)

An analysis of Figure 4.10 indicates that Mark showed a slight decrease while the other four subjects increased their average per session time during the month of February. This was followed the next month with a decrease in their average per session time by all five subjects. This initial up and

down movement depicted here may be an aspect of the subjects' excitement and their opportunity to explore written language and play with a new writing tool.

Through the second half of the data collection period, each subject, other than Martha and Rachel, displays a different time commitment pattern. Throughout the study Martha and Rachel were almost mirror images of one another as they increased their average time commitment per session. Other than the subjects' general increase of committed time during February followed by decreases in March, and the mirror image of Martha and Rachel, other patterns displayed in Figure 4.10 are specific to individual subjects.

Following the general March decrease, two subjects decreased their time commitments at one point or another during the last half of the data collection period. Even discounting Christy's non-participation during the one-word-processor-available-week in June, therefore no monthly average for June, her trend after February was downward. When analyzing Table II and Tables IV and VI, it becomes apparent that as Christy's literacy became more sophisticated, she spent less time using a word processor. Table IV illustrates that Dave had a six minute session in May as well as three in the mid teens during his final print literacy episode. The effect of these short sessions was to decrease his average per session time during the months of May and June, as illustrated in Table IV. Except for Dave's

May decrease, after the February peak, Christy is the only subject to exhibit a steady downward trend.

Patterns and trends concerning time which are illustrated in Figure 4.10 and Tables II, IV, and V, are substantiated by data contained in Table VI. In addition to presenting monthly total amounts of time and averages, this data base also includes cumulative total and average times. Examining the numbers and patterns in Figure 4.10 and Table VI permits one to observe the increase or decrease in monthly amounts of time that subjects committed to using word processors. These numbers also allow comparison between subjects: those who spent a large number of minutes with word processors, like Dave, and those, like Rachel who spent less time. Copies of these data illustrating highs and lows of the various categories are included in Appendix E.

TABLE VI

DATA BASE DEPICTING; MONTH OF STUDY, MONTHLY TIME,
CUMULATIVE TIME, MONTHLY AVERAGE TIME,
AND CUMULATIVE AVERAGE TIME OF
SUBJECT'S INVOLVEMENT WITH
WORD PROCESSORS

File: Time Analysis Page 1
Report: Individual

Subject	Month	Total Time	Cumulative Time	Average	Cumulative Average
Martha	1	53	53	10.6	10.6
Martha	2	108	161	13.5	12.1
Martha	3	62	223	10.3	11.5
Martha	4	69	292	9.9	9.9
Martha	5	86	378	14.3	11.7
Martha	6	15	393	15	12.3
Christy	1	98	98	19.6	19.6
Christy	2	130	228	26	22.8
Christy	3	98	326	16.3	20.6
Christy	4	82	408	13.7	18.7
Christy	5	30	438	10	17.1
Christy	6		43	0	17.1
Dave	1	160	160	26.7	26.7
Dave	2	131	291	32.8	29.7
Dave	3	169	460	28.2	29.2
Dave	4	203	663	40.6	33.4
Dave	5	208	871	23.1	30.3
Dave	6	68	939	22.7	29
Rachel	1	13	13	6.5	6.5
Rachel	2	80	93	13.3	9.9
Rachel	3	64	157	9.1	9.7
Rachel	4	49	206	9.8	10.4
Rachel	5	24	230	12	10.2
Rachel	6	12	242	12	10.5
Mark	1	51	51	17	17
Mark	2	80	131	16	16.5
Mark	3	57	188	14.3	15.8
Mark	4	85	273	17	12.9
Mark	5	160	433	40	20.9
Mark	6	171	604	42.8	24.5

Analysis of data displayed in Tables IV through VI and Figure 4.10 reveal that there are no apparent relationships between individual subject episodes of print literacy evolution, illustrated in Table II, and the amount of time subjects spent in each of their episodes. Tables IV and V illustrate that even though subjects' average print literacy episode time may be similar, their total times are vastly different. Times for print literacy episode 2, displayed in

Table IV, illustrates that the three female subjects spent relatively the same amount of time per session, yet their total times were quite different. Also displayed within these figures and tables where total times are similar, per session times are often quite different. Table IV displays a one minute difference in total time spent for Dave's and Mark's print literacy episode 4, yet there is a vast difference between their individual per session time with a computer.

Examining Table II and Table VI reveals that there is no apparent relationship between the amount of time one uses a word processor for these subjects and their print literacy sophistication. Table II illustrates that both Martha and Dave were writing stories by the end of their third month using a computer. Examination of Table VI reveals that by the end of the third month, Martha spent a total of 223 minutes with computers while Dave's time with a computer was 460 minutes. Although Dave spent twice as much time with word processors, both Martha and Dave began writing stories during the same week. These same figures and tables reveal that compared to Martha and Dave, Christy would not write stories for another six weeks, yet she spent 326 minutes with word processors by the end of the third month. Christy, not demonstrating the print literacy sophistication of Martha or Dave, spent 100 more minutes than Martha but 140 minutes less than Dave. Further examination of these figures illustrates

that per session time also supports the trend of no apparent relationship between time spent with a word processor and print literacy sophistication.

In summary, there are five apparent trends of interest represented in the time data. Except for Mark's slight decrease in February, one is the upward and then downward pattern exhibited by all subjects during the first three months of the data collection period. Secondly, there is Christy's continued downward trend after she peaked in February. Her written literacy continued to become more mature, as did that of the others, but her use of the word processor declined. Another interesting trend is the near mirror image of Martha and Rachel in their average time spent with a word processor illustrated in Figure 4.10. A fourth trend is no apparent relationship between individual subject episodes of print literacy evolution and the amount of time subjects spent in each of their episodes. Finally, there is no apparent relationship between the amount of time spent with a word processor and individual subject's print literacy sophistication. Other than these five, it appears that with regard to time commitments in using a word processor, there were no other significant findings during this investigation.

Question - 2.

How do the physical attributes of the computer environment influence children's behavior associated with word processing? For example: screen color or computer location.

Screen Choice. As data accumulated concerning choice of screen display, patterns and trends did not materialize. Figure 4.11 displays two data files which exhibit screen format preference data for two subjects. When analyzing this figure, it appears that neither of these two children possessed a preference for one screen display over another. The closest that either of them came to demonstrating a preference was Mark's choice of screens with color displays during the month of February.

File:	Mark	Choice		File:	Rachel	Choice	
Date	Mono.	Color	Choice	Date	Mono.	Color	Choice
Jan 12	x		x	Jan 14		x	o
				Jan 20	x		o
				Jan 21		x	o
Jan 22	x		x	Jan 29	x		o
Jan 26	x		o	Feb 2		x	o
Jan 27		x	o	Feb 3		x	o
Feb 2		x	o	Feb 9	x		o
Feb 3		x	o	Feb 12		x	x
Feb 9		x	o	Feb 18	x		o
Feb 11		x	o	Feb 19		x	o
Feb 17		x	o	Feb 26	x		o
Feb 26		x	o	Mar 3		x	o
Mar 4		x	o	Mar 4	x		o
Mar 11	x		o	Mar 12	x		o
Mar 12		x	o	Mar 17	x		o
Mar 19	x		o	Mar 19	x		o
Mar 30		x	o	Mar 30		x	o
				Apr 1	x		o
Apr 10	x		o	Apr 6		x	o
Apr 13	x		o	Apr 9		x	o
Apr 16	x		o	Apr 16	x		o
Apr 20	x		o	Apr 27	x		o
Apr 28		x	o	Apr 30	x		o
May 4		x	o	May 12	x		o
May 14		x	o	May 22		x	o
May 14	x		o	Jun 2		x	o
May 18		x	o				
May 26	x		o				
Jun 2		x	o				
Jun 3		x	o				
Jun 4		x	o				
Jun 5	x		o				

Figure 4.11 Data base depicting Mark and Rachel's screen preference.

Although neither Mark's nor Rachel's data base displayed in Figure 4.11 appears to indicate a preference, when reconfigured in graph form a preference is evident. Consider the bottom of Figure 4.12: Mark's choice of screen indicates that he chose color screens 2 to 1 over that of monochrome screens. Analyzing Rachel's graphed screen selection data,

appear to favor a specific screen display. Of the five study subjects, two appear to indicate preference for color screen displays while three possess no apparent preference.

Computer Choice. Figure 4.13 illustrates hardware (computers and printers) positions in the word processor center. Within this center, two printers are color coded and networked to the word processors. Each printer supports three word processors. Monitor screens are positioned in such a manner that when sitting at one, a child is looking toward the middle of the learning center. If a child were to sit at computer "Green 3," s/he would face toward the west wall while most of the room would be to his/her back. Further examination indicates that a child sitting at computer "Blue 2" would face toward the middle of the room with windows to his/her back. While there was little foot traffic along the windows (south) and wall (west) sides of this learning center, children sitting at the green computers often had others walking behind and next to them.

Figure 4.13 Diagram of word processor center.

Children were observed to cruise the word processor center, walking around the center looking at monitor screens and students writing. As subjects cruised the word processor center looking for a word processor, they were often limited to their choice of computer. Commonly, other students were already using them to write. Even though this was generally the case, certain trends and patterns of use emerged. While certain subjects appeared to possess a preference for specific computers, other subjects appeared to avoid certain computers or locations within the center. Figure 4.14, a display of Dave's computer choice data base, reveals his initial preference for computer "Blue 1." As indicated in Figure 4.14, Dave's preference extended through the initial three months of his access to the writing lab and word processor center.

File: Dave Choice		Page 1						
Report: Analysis								
Date	Blue 1	Blue 2	Blue 3	Green 1	Green 2	Green 3	Choice	
Jan 13	x						0	
Jan 14					x		0	
Jan 20	x						0	
Jan 21	x						0	
Jan 22					x		x	
Jan 27	x						0	
Jan 29	x						0	
Feb 4	x						x	
Feb 11					x		0	
Feb 17	x						0	
Feb 17	x						0	
Feb 18	x						0	
Feb 23	x						0	
Feb 26	x						0	
Mar 3		x					0	
Mar 11	x						0	
Mar 17	x						0	
Mar 18		x					0	
Spring Break								
Mar 31	x						0	
Apr 1	x						0	
Apr 2		x					0	
Apr 8		x					0	
Apr 22					x		0	
Apr 23		x					x	
Apr 27					x		x	
Apr 29				x			x	
Apr 29			x				x	
May 5	x						0	
May 6					x		0	
May 7				x			x	
May 11						x	0	
May 12	x						0	
May 13			x				0	
May 19						x		
May 19			x				0	
May 21				x			0	
May 22		x					0	
May 22						x	0	
May 26		x					0	
May 27					x		0	
Jun 2					x		x	
Jun 3	x						x	
Jun 4						x	x	

Figure 4.14 Display of Dave's computer choice data base.

Twice during the first three months I recorded Dave's initial commitment and preference for computer "Blue 1" in my "Dave Journal." His actions and behaviors indicate his intent at wanting to use this particular computer.

1/29/87 Thursday

There were four computers available today when Dave arrived at the WP center. He waited until Ryan completed her work at the one ["Blue 1"] she was at, [Dave] cleared the screen with confirmation directions from me, and then sat down and began to work.

2/26/87 Thursday

What I thought was interesting this morning is that on the way to the writing table [from the CAI computers], Dave diverted his path to the WP center. There he coerced Matthew away from the B1 [Blue 1] WP [word processor] and began to use it himself. Matthew was almost finished with his work anyway, but by the time Dave told him he was wrong and off task and told him to clear[,], which is what Matthew was going to do anyway, Matthew left and the B1 WP was open to Dave to use, which he did.

Following Spring Break, as indicated in Figure 4.14, Dave began to diversify his word processor selection. During the last two months of the data collection period, Dave no longer indicated a preference for a specific computer.

While Dave indicated a preference for a particular computer, another choice pattern to emerge was that of the apparent avoidance of computers located in certain sections of the word processor center. Examination of Table VII illustrates that both Christy and Mark appeared not so much to prefer certain word processors, but to avoid specific areas of the center. Christy displays a tendency to avoid using word processors "Blue 1" and "Blue 2" while Mark appears to avoid using "Blue 1" and "Green 3". The two computers which Christy declines to use have the most amount of natural light hitting their monitor screens. Her avoidance may be a preference to use computers with lighting sources from above rather than behind. Christy is physically

very small, much smaller than the other subjects. Her size, in relation to those two particular computers and their lighting may be an aspect to her avoidance. Mark's avoidance of "Blue 1" and "Green 3" allowed him to sit at word processors where he could look around and standing up look over monitors to see what was occurring in other parts of the room. Mark was commonly involved with others, socializing, when working at the word processor center as the following entries in my "Mark journal" indicate. Mark's social involvement with others extended beyond the word processor center.

3/4/87 Wednesday

He was out of his seat quite often talking with other kids or looking at what they were doing at their WP. At times he also seemed much louder than at other times. Although he wrote more today than any other time I've observed him, he also wasn't as focused, out of his seat, talking to others, and movement about the WP center.

6/3/87 Wednesday

Mark was up and out of his seat a great deal today, almost every little thing set him in motion away from the activity of being focused on his WP work. At times he was off looking at other people's screens which included comments at times on what he saw. Other trips out of his seat included chats with others about what they were writing, wanting to help others, how to write a certain punctuation mark or discussion about the content of what was being written.

TABLE VII
COMPOSITE OF SUBJECT'S WORD PROCESSOR CHOICE*

Frequency						
16	Dave					
15						
14						
13						
12						
11						
10						
9						
8			Mark		Christy	Martha
7		Martha	Christy		Rachel	
6		Mark				
5		Dave	Rachel	Martha	Martha	Christy
				Christy	Mark	Rachel
4			Martha	Mark	Dave	
3	Martha			Rachel		Dave
2	Rachel		Dave	Dave		
1	Christy	Christy				Mark
	Mark	Rachel				
<hr/>						
	Blue 1	Blue 2	Blue 3	Green 1	Green 2	Green 3
			Word Processor			
<hr/>						

*Martha N = 34, Christy N = 29, Dave N = 33, Rachel N = 25, Mark N = 27.

Rachel displayed a similar pattern to that of Christy's. She appeared to avoid using "Blue 1" and "Blue 2." However, since Rachel's data does not indicate as many word processor center contacts, her trend does not seem as pronounced as Christy's. Rachel appears more diversified, but not to the extent of Martha. Martha's contacts were spread throughout the word processor center. Individual print outs of each

subject's computer choice data base displaying computer and screen choices is contained in Appendix G.

Percentage data displayed in Table VIII collaborates these findings. Table VIII displays percentages of the subject's word processor choices. Dave's preference was for word processor "Blue 1" and he chose that computer 48% of the time. Christy used "Blue 1" and "Blue 2" each 3% for a total avoidance of that area of the word processor center of 94%. Mark used "Blue 1" and "Green 3" each 4% for a total avoidance time of that area of the word processor center of 92%. When examining Tables VII and VIII it becomes apparent that certain trends towards the use or avoidance of particular computers existed, but these data do not explain why.

TABLE VIII
PERCENTAGE OF SUBJECT'S WORD PROCESSOR CHOICES

A question which emerges when examining this data is: did Dave monopolize word processor "Blue 1" to the extent that others had little opportunity to use it? As indicated

in Figure 4.10 and Table VI, Dave usually occupied a computer for approximately one half hour. His behaviors were such that his peers probably became aware of his preference for "Blue 1". From his initial word processor access in January until April 1, Dave was at the word processor center 20 times, 18 of which he had a choice of which computer to use. During this time period, the subject's class visited the writing lab 50 days. Over 60% of the days, Dave did not participate in the word processor center. As previously expressed in my journal entries, other non-subject students, Ryan and Matthew, in addition to study subjects were using this particular computer. Although Dave utilized "Blue 1" often, this computer was an available option to other students.

Use of Printer. From the beginning of their access to the writing lab, students used printers networked to the word processors. Initially adults printed for students, but as adults demonstrated and explained the printing process, students began to learn about computer systems. Within a few days, students were manipulating keys and switch box dials as adults led and talked them through the printing process. As indicated in Figure 4.15, within a month, two subjects were able to manipulate the computer system in order to print a hard copy of their own document. However, there were those who had difficulty managing the printing procedure and one who never printed her own documents.

Behavior by adult	Martha Christy Dave Mark	Martha				
by peer		Martha Rachel		Martha	Mark	
with adult	Martha Christy Dave Rachel	Martha Christy Dave Rachel Mark	Martha Christy Dave Rachel Mark	Martha Christy Dave Rachel Mark	Martha Christy Dave Mark	Rachel
with peer		Martha Christy Mark	Christy Rachel	Christy Rachel Mark	Martha Christy	
by self	Dave	Martha Dave	Martha Dave	Martha Dave Rachel Mark	Martha Dave Rachel Mark	Martha Mark
<hr/>						
	January	February	March	April	May	June
<hr/>						

Figure 4.15. Composite of subject's involvement in the printing process during the study.

Growth in Figure 4.15 is represented by movement from the upper left corner down towards the bottom right corner. Since two subjects did not have the opportunity to print during June, there are only three names in the column for that month. This figure indicates that by the fourth month of their involvement with a computer system all subjects, except for one, were able to manipulate the technology in order to print for themselves. After the first four to six weeks, generally, adult assistance was only necessary if there were printer or software problems, or simply for confirmation about the process. Once children understood the printing procedure, peer assistance became common and was observed usually to be on the basis of sharing and wanting to be

helpful as opposed to having to help someone because they were unable to print on their own. At times some of this assistance was unsolicited as illustrated in the following entry from my "Martha Journal."

2/18/87 Wednesday

Martha came back for a second time today. She initially began the day at the WP's and then finished the day there also. It's interesting to note that when she was there, both times, she did a lot of helping or wanting to help kids print. She did this even when kids didn't want her help. Rachel told her that she didn't need any help from her, but Martha kept right on interacting with her, telling her what to push and pushing some keys herself.

Illustrated in Figure 4.15, and substantiated by the data base information displayed in Figure 4.16, Christy never completed the printing process on her own. She followed adults and peers through the printing process and attempted it herself many times. The following entry, taken from my "Christy Journal," explains the technique adults used with Christy and other students to teach the printing process. This entry also illustrates one of Christy's attempts to print on her own.

3/10/87 Tuesday

She then got into printing and clearing. This took the majority of her time at the WP. At first she told Brenda she wanted to print. Brenda asked if she knew how and she confirmed that she did. Next she went back to the WP and tried for the longest time to print. She didn't have much success with it [printing process]. She tried a number of times, but often missed the print selection on the edit screen. She finally went to Brenda and requested some assistance. Brenda then verbally took her through the printing process telling her what to do each step of the way and allowing Christy the opportunity to do it [manipulate the technology].

File: PubChart Christy		Page 1			
Report: Analysis					
Date	by adult	by peer	with adult	with peer	by self

Jan 12	x				
Jan 20	x				
Jan 22	x				
Jan 22			x		
Jan 26			x		
Jan 27	x				
Feb 10			x	x	
Feb 13			x		
Feb 18			x	x	
Feb 20			x		
Feb 26			x	x	
Mar 10			x		
Mar 11			x		
Mar 12			x		
Mar 16			x		
Mar 17			x		
Mar 18				x	
Mar 30				x	
Mar 31			x		
Apr 7				x	
Apr 13				x	
Apr 17			x		
Apr 21				x	
Apr 27			x		
Apr 30			x		
May 1			x	x	
May 5			x		
May 13			x		
May 19			x		

Figure 4.16 Display of Christy's printing behaviors data base.

The growth pattern displayed in Figure 4.16 moves from the upper left to the lower right corner. Upon examination, one observes that Christy moved towards self-sufficiency but always had to rely on another's assistance. Data bases contained in Appendix H indicate that there was a wide variety in how quickly subjects gained skills in manipulating the printing process. Dave and Martha were the first subjects to successfully print their own documents. Figure 4.15 illustrates the three month spread between the first subject, Dave, and the last subjects, Rachel and Mark, to demonstrate self-sufficiency in printing.

In reference to Chapter II and the section on cognition, young children find it difficult to mentally visualize the whole of something and its parts simultaneously. When printing at one of Sabin's PCJr. computers, not only must an operator manipulate the software, but they must also turn the network box switch to the number of the computer they are controlling. In order to turn the switch it is necessary for the writer to physically move from his/her computer to the printer switch box located next to the printer, turn the switch, return to his/her word processor and follow the software printing commands. This procedure appeared confusing to some children. The following entry is taken from my "General Journal."

3/12/87 Thursday

There appears to be a hang up for some kids when it comes to printing. The procedure is fairly straight forward, but suddenly there are problems when they get to the point of the switch box. They can print or at least follow the procedure to print, but when it comes to going through the print procedure and then going over to the switch box to turn to the correct number of [the] WP, they lose where they are. They are trying, but the ambiguity of the setting may give them problems. The switch box is not on the procedure card. Maybe if that was included more kids would go ahead and print? Yet, it's not the most clever kids or anything like that who can print or can't, it's a number of children. I wonder what the variables are which are working here?

This entry was written in mid March. By the first week in June, almost every member of the class was able to complete the printing procedure on his/her own. Of the research subjects, Christy was second youngest and still not a self-sufficient printer. In contrast, as Figure 4.17

illustrates, once Mark, second oldest, demonstrated that he could print on his own, often required peer and adult assistance. In reference to Table II, Christy and Mark appear to be the least sophisticated in print literacy. According to data contained in Figure 4.15, they are also the least sophisticated in printing their own documents.

File: PubChart Mark		Page 1				
Report: Analysis						
Date	by adult	by peer	with adult	with peer	by self	
Jan 12		x				
Jan 22		x				
Jan 23		x				
Jan 27		x				
Feb 3						
Feb 7			x		x	
Feb 11			x			
Feb 17				x		
Feb 26			x			
Mar 4			x			
Mar 11			x			
Mar 12			x			
Mar 19			x			
Mar 30			x			
Apr 10			x		x	
Apr 13					x	
Apr 16					x	
Apr 20						x
May 4			x			
May 14						x
May 18						
May 26				x		
Jun 2	x					
Jun 3	x					
Jun 4	x					
Jun 5						x

Figure 4.17 Display of Mark's printing behaviors data base.

Regarding Figure 4.17, the three June entries in the column "by adult" refer to my saving Mark's document on a file disk since Mark was copying from a book and asked to have his text saved each day for retrieval the following day. On Friday June 5, Mark printed multiple copies of his

document using both the software printer controlled functions and the hardware controlled print screen function.

Daily publishing of one's document was a common activity in the word processor center. Figure 4.18, a display of relevant data from Dave's "PubChart" data base, indicates the popularity of printing during each word processor contact session. It is apparent from this figure and data bases contained in Appendix H that subjects desired a copy of their document. Initially, subjects printed copies for themselves, but in time began to share their document with others. As illustrated in Figure 4.18, Dave shared print outs of his document as well as received documents from peers. During the last few days in June, Dave had his document saved since he was copying from a book and intended to print his entire document when finished. School closed for summer break before he had an opportunity to publish.

File: PubChart Dave
Report: Print Analysis
Date by adult with adult by self # shared with

Jan 13		x	1	
Jan 14	x		1	
Jan 20		x	1	
Jan 21		x	1	
Jan 22	x		1	
Jan 27		x	1	
Jan 29			x 1	
Feb 4		x	1	
Feb 11			x 1	
Feb 17		x	1	
Feb 18			x 1	
Feb 23			x 1	
Mar 2			x 1	
Mar 3			x 6	in his home
Mar 11			x 1	
Mar 17			x 1	
Mar 19		x	1	print screen
Mar 26			x 1	
Mar 31		x	3	reg. prt scrn. me
Apr 1		x	5	prt scrn-friends
Apr 2			x 1	prt scrn, me
Apr 8			x 1	
Apr 22				saved
Apr 23		x	1	
Apr 29			x 0	*cleared*
May 5			x 2	1 mistake
May 6			x 1	print screen
May 7			x 1	print screen
May 11			x 1	print screen
May 11		x	2	prt scrn-files list
May 12			x 2	me
May 13			x 1	
May 21			x 1-5	helping others
May 22			x 2	reg. prt scrn
May 26			x 1	received copy-Matthew
May 27			x 1	
Jun 2				saved
Jun 3				saved
Jun 4				saved

Figure 4.18 Display of relevant data from Dave's data base.

The following entry from my "Dave Journal" indicates the sharing of personally printed documents. It also offers examples of meta-linguistics practiced among peers, assisting peers in printing, and collegial sharing and writing.

5/26/87 Tuesday

Dave and Matthew worked together for 55 minutes today. Initially they were into exploring and doing the old print screen stuff. This also included helping other kids work out the printing. After about 10 or 15 minutes they got into writing words and short phrases. Some of the kind of stuff that Dave used to do before he began to write stories. The

two of them did a lot of talking back and forth about their work and their writing. They were sharing ideas. This didn't get into sharing the spelling or sounding out as long as I was observing their interactions. But they did a lot of sharing about the topics and words they wanted to write. At one point the sub [substitute teacher] came over and told the two to stop the playing and get on with their work. They explained what they were doing and then continued on with their writing. When it was time to print, they both shared copies of their own work with one another.

Letter Preference. Associated with publishing one's written documents is the use of letter form, ie. upper, lower, conventional, or mixed case format. In this study, subjects displayed a variety in their use of letter formats. An analysis of Figure 4.19, individual subject data bases contained in Appendix I, and Tables IX - XI, indicates that some subjects held certain preferences while others appear to hold none. Further analysis of Figure 4.19 indicates no apparent trends within the group of subjects, the data illustrates individual preferences.

Martha		N = 35
Upper	XXXXXXXXXXXXXXXXXXXX	18 - 51%
Lower	XXXXXXXX	9 - 26%
Mixed	XXXXXXXX	8 - 23%
Christy		N = 25
Upper	XXXXXX	6 - 19%
Lower	XXXXXXXXXXXXXXXXXXXX	21 - 68%
Mixed	XXXX	4 - 13%
Dave		N = 33
Upper	XXXXXXXXXXXXXXXXXXXXXXXXXXXX	28 - 85%
Lower		0 - 0%
Mixed	XXXXX	5 - 15%
Rachel		N = 25
Upper	XXX	3 - 12%
Lower	XXXXXXXXXXXXXXXXXXXX	14 - 56%
Mixed	XX	2 - 8%
Conv.	XXXXXX	6 - 24%
Mark		N = 25
Upper	XXXXXXXXXXXX	11 - 44%
Lower	XXXXXXXXXXXX	12 - 48%
Mixed	XX	2 - 8%

Figure 4.19 Graph of subject's letter choice form. Conv. in Rachel's section refers to conventional letter format.

The preferences indicated in Figure 4.19 are substantiated by individual percentages displayed in Table IX. While Dave and Martha indicate a preference for using upper case letters, Christy and Rachel display a preference for using lower case letters. Rachel was the only subject to display the use of letters in a conventional fashion. Her use of letters may have been a result of letter play more

than knowledge of English language conventions since she did not capitalize nouns with any consistency but would often capitalize word strings. Regarding data contained in Figure 4.19, Table IX, and Appendix H, children displayed little mixing of letter cases.

TABLE IX
COMPOSITE OF SUBJECT'S LETTER FORM CHOICE PERCENTAGE

Tables X and XI display two subject's "Letters" data bases, one indicating an apparent letter format preference, the other no preference. As illustrated in Table X, Dave's

use of upper case letters 85% of the time indicates that he prefers the use of upper case letters. Analysis of the comments column indicates that four out of the five times Dave mixes upper and lower case letters, the vast majority of letters in his document are upper case. In contrast, data displayed in Figure 4.19 and Tables IX and XI indicate that Mark, with selection percentages near 50%, appears not to possess a letter format preference.

TABLE X

DATA BASE DISPLAY INDICATING Dave'S
LETTER FORM CHOICE

File: Letters Dave			Page 1		
Report: Analysis					
Date	Upper	Lower	Mixed	Conventional	Comments
Jan 13			1		
Jan 14			1		mostly upper
Jan 20			1		mostly upper
Jan 21			1		mostly upper
Jan 22			1		mostly upper
Jan 27	1				
Jan 29	1				
Feb 4	1				
Feb 11	1				
Feb 17	1				
Feb 18	1				
Feb 19	1				
Feb 26	1				
Mar 2	1				
Mar 3	1				
Mar 11	1				
Mar 17	1				
Mar 19	1				
Mar 31	1				
Apr 1	1				
Apr 2	1				
Apr 8	1				
Apr 22	1				
Apr 23	1				
May 5	1				
May 6	1				
May 7	1				
May 11	1				
May 12	1				
May 13	1				
May 22	1				
May 26	1				
May 27	1				

Total	28		5		
Percentage	85%		15%		

TABLE XI
DATA BASE DISPLAY INDICATING Mark'S
LETTER FORM CHOICE

File: Letters Mark		Page 1		
Report: Analysis				
Date	Upper	Lower	Mixed	Conventional
Jan 12			1	
Jan 22			1	
Jan 26	1			
Jan 27		1		
Feb 9		1		
Feb 11		1		
Feb 17	1			
Feb 26	1			
Mar 4		1		
Mar 11	1			
Mar 12	1			
Mar 19		1		
Mar 30		1		
Apr 10		1		
Apr 13	1			
Apr 16		1		
Apr 20	1			
May 4	1			
May 14	1			
May 18	1			
May 26		1		
Jun 2		1		
Jun 3		1		
Jun 4		1		
Jun 5	1			
Total	11	12	2	
Percentage	44%	48%	8%	

ADDITIONAL FINDINGS

The following two incidents occurred during preliminary research conducted in 1986. The first incident occurred during the Spring. At that time, preliminary research was being conducted in two of five kindergarten classes scheduled for an hour each day in the writing lab. No one associated with these two classes realized what had evolved until April, during the kindergarten students' fourth month of access to word processors and the writing lab. At that time it was discovered that in both classes, with the exception of one

girl, all students who took control of the computer system and exhibited publishing self-sufficiency were boys. When finished writing, girls would continue to sit quietly, raise a hand and wait until an adult, who noticed their signal, came and printed their document for them. Meanwhile, many of the boys had learned early on, as Dave did, how to control the computer system and publish their own documents.

Not an expected development, this gender phenomenon simply evolved. The only exceptions to this tendency were boys who generally did not appear as intellectually and socially mature as their classmates. It appeared that these boys were often viewed as not "being able" and needing help. As indicated by data presented earlier, Figures 4.15 to 4.18 and other related figures in Appendix H, a discrepancy of this magnitude did not materialize this year.

The second incident occurred in late September 1986. I was using overhead transparencies in a workshop on the use of word processors with young children. The transparencies were samples of students' work without names, similar to Figure 4.2, representing evolutionary literacy growth of kindergarten students. Attending this workshop was a teacher new to our building. Two subjects from the preliminary study were in her classroom. While I was displaying Nadir's literacy growth transparencies, the teacher spoke up and asked if it was Nadir's work. This incident is significant in light of Brisk's (1985) research reported in chapter 2:

"Neither the word processor nor the printer revealed the identity of the 'real' author" (p. 28). Though personal handwriting style can not be utilized for identifying authors who use a word processor, it is apparent that there can be other characteristics of written language to assist in identifying authors.

CHAPTER V

SUMMARY, FINDINGS, AND CONCLUSIONS

SUMMARY

Restatement Of The Problem

During this decade of the 1980s, many young children are experiencing the opportunity to use microcomputers. It is not uncommon for kindergarten students to use microcomputers as word processors. Computers are literacy tools new for school curricula, educational leaders, and young children. Various scholars have proposed questions related to young children using these machines in their print literacy development. Newman (1984B) shares these questions concerning

... software and computer-based language learning activities:
What role does the computer play in these learning experiences?
What is the teacher's role?
To what extent does this software let learners take control of their own learning?
Does it facilitate a sharing of knowledge? (p. 762)

Spencer and Baskin (1983) pose questions directly related to word processing and early childhood education.

When is a child old enough to effectively use a word processing program to type letters of the alphabet, numbers, and other symbols?

At what point can a word processor aid a child in beginning to write simple sentences, paragraphs, stories, or poems? (p. 21)

These questions and others found during a survey of related literature led to the formulation of a study statement and questions which became the focus of this investigation.

Study Statement

If given the opportunity, how will children use word processing in their print literacy development during their kindergarten experience?

Procedure. Since the opportunity for children to use computers is a recent phenomenon in early childhood education, it was felt that a research design utilizing certain ethnographic techniques provided the most promising and valuable approach. Study questions were developed and refined. Following more than a year of preliminary research, review of relevant literature, discussions with professionals in related fields, and development of a naturalistic research design, the formal data collection period of this investigation began in January 1987.

Study Questions.

1. What developmental sequences related to print literacy reveal themselves as kindergarten children use a word processor?

1a. In what ways are these sequences the same as or different from those identified by researchers studying young children's use of pencil and paper?

1b. What type of time commitments do children make at each stage of these developmental sequences?

2. How do the physical attributes of the computer environment influence children's behavior associated with word processing? For example: screen color or computer location?

Subjects. Originally, six children representing a variety of intellectual, racial, and economic backgrounds were selected as subjects. Within six weeks, one of the subjects moved to a new school and was lost to the study.

Data Collection. The formal investigative-observational data collection period of this study continued for approximately 5 months. Observations were conducted and recorded daily with follow up journal entries. Subjects' literary products were saved and collected daily. Also, portions of the recorded data were transferred to refining instruments both daily and weekly.

Data Collection Instruments. Once the study questions were finalized, various data collection and analyzing instruments were created. These instruments were created in paper and ink as well as electronic form. In addition, it was decided to keep seven journals, one for each of the subjects plus a general journal for recording group and

classroom word processor, print, and technology related behaviors. Except for the journals, which consist of typical log type entries, examples of these recording and refining instruments are contained in the Appendices.

Data Analysis. As the recorded data began to accumulate, certain patterns, trends, and themes became apparent among the subjects. These patterns, trends, and themes generally became clearer once the data collection period was completed and analysis begun. Analysis of the collected data leads to the following three sections: findings, conclusions, and recommendations.

FINDINGS

Subjects' Print And Technological Sequences

Print Literacy. Subjects' print literacy skills and abilities appeared to evolve through three sequential stages of development which I titled: "Gobbledygook," "Copying," and "Writing." Behaviors inherent to each stage were present in other stages as subjects' print literacy evolved.

Technological Literacy. Subjects' technological literacy skills and abilities evolved in an apparent sequential fashion e.g., children learned to print a "hard copy" of their text, clear their text from the screen, and eventually began to learn to save their text.

Intertwining of Print Literacy and Literacy of Technology. Both print literacy and literacy of technology

evolved simultaneously. Intertwined and integrated with subjects' print literacy development was their literacy of technology development.

Individual Episodes of Growth. Subjects exhibited individual episodes of print literacy development.

Cycling of Print and Technological Behaviors. As subjects became increasingly more sophisticated with print and technology, they continued to employ and integrate less mature print and technological behaviors. They continued to mature, but continued to employ earlier learned and developed skills and abilities.

Discussion. Print literacy behaviors were grouped into three categories: "Gobbledygook," "Copying," and "Writing." These categories are more useful for purposes of description than as distinct stages of development since there is considerable overlap between them. Subjects generally began their literacy growth with word processors in the "Gobbledygook" category, playing and exploring with print. This was followed by their evolving into and towards the categories of "Copying" and "Writing." Typically, subjects exhibited two or three of these categories during a writing session with a word processor. Play and exploration were often integral components of children's copying and writing. Subjects appeared to continuously cycle through these categories as their print literacy evolved.

In order to complete their documents, subjects needed to know a certain amount of knowledge about word processor technology. As subjects' print literacy matured, these budding written language users acquired additional knowledge of technology. In addition to discoveries made by themselves or shared by peers, knowledge of technology developed on a need-to-know basis. Adults also shared technological knowledge about word processors.

Subject-specific episodes of print literacy evolution were revealed during the five months of data collection. These print literacy episodes represent individual subject's change in written language sophistication. Subjects exhibited continuous growth during the study in addition to specific episodes of print literacy evolution.

An integral component of this evolution and development are those skills and behaviors titled "Dilly-Dallying." These behaviors--reading, speaking, listening, sharing, manipulation of the technology, and more--evolved simultaneously with writing behaviors. These findings concur with those of Brisk (1985), Heap (1986), and Phenix and Hannan (1984). As with writing behaviors and skills, these behaviors and skills also cycled along the print and technological continuums. Subjects were commonly observed to use written language knowledge to explore the technology and the technology to explore written language. There was a

continuous intertwining and integration of print literacy and the literacy of technology.

Pencil, Pen and Paper System -- Computer System.

Evolution of Written Language. There were no apparent differences between these systems in relation to individual subject's evolution of written language.

Discussion. Although this was not a comparison study of the pencil, pen and paper system of written language versus the computer system, certain conclusions can be drawn from the findings. Subjects' print literacy growth using a word processor was similar to that of children using pencil and paper. Subjects matured in their own wholistic manner, cycling back to less sophisticated behaviors while simultaneously advancing along their own literacy continuum. These findings do not appear to be dissimilar to Clay's (1975) observations of children using a pencil and paper system: "Observation of children suggests that they do not learn about language on any one level of organization before they manipulate units at higher levels" (p. 19). These findings are also similar to the views of other scholars such as Harste et al. (1984) who write about the evolution of literacy as a continuum instead of focusing on specific developmental stages:

Current yardsticks divert attention away from growth and toward 'developmental stages,' which attempt to calculate growth by marking surface level features of conventional form. Such a focus

draws our attention away from the universals of written language literacy, which operate across language users at all ages and simply express themselves in a variety of alternative forms. It limits our thinking about literacy. Literacy becomes a step-by-step progression of control, not a vehicle for exploring and expanding our world (p. 12).

It became increasingly apparent that subjects exhibited a movement towards mature print literacy in the print literate environment of the writing lab. It was obvious that, for these young children using a word processor, their process of becoming literate was similar to the vehicle (learning written language in a print-laden society) for exploring and expanding worlds as referenced by Harste et al. (1984).

The major difference between these systems lies with the technology of the associated tools. There appears to be much more of an interconnection between print literacy and the literacy of technology when word processors are used by young children than when they employ pencil and paper. Subjects were learning written language while learning to control technology. While it appears to take only a few writing sessions to learn the technical characteristics of a pencil, it takes many to learn those of a word processor. It was observed that print and technological literacy behaviors were intertwined as subjects' understanding of literacy evolved.

Subjects' Time Commitments

Time Commitments. Except for one (see below), each subject exhibited individual time commitments, per session, per month, and per individual episode of print literacy development.

Time to Literacy Growth. No apparent relationship was revealed between time commitments and print literacy growth.

Time Patterns and Trends. There were a variety of time patterns and trends unique to individual subjects. An interesting pattern occurred during the first three months: generally, subjects' time per session increased during the second month and decreased the third month.

Discussion. Time commitments were subject-specific. Except when assigned to a word processor, which was very infrequent, subjects decided how long they would write with a word processor. Since individual classes were allotted only an hour a day to visit the writing lab, at times, closure of that period and returning to their classroom interfered with subjects' length of time using a word processor. On the basis of time per session, month, and natural episode, each subject displayed individual time commitments.

Other patterns and trends of interest related to time commitment also occurred. One is that subjects' average per word processor session committed time increased in February followed by a decrease in March. Four of the five subjects exhibited such a pattern. This general trend may be an

aspect of children trying a new toy or tool; initially there is a great deal of play which is then incorporated into their repertoire of understanding and therefore later does not receive as much exploration type of attention.

Although there was a continual increase in print literacy and literacy of technology knowledge, there was no apparent relationship with time. Except for one, all subjects' print literacy abilities and skills matured while their time commitment to the word processor generally moved up and down or gradually up. One of the subjects decreased her time with a word processor as her print literacy and literacy of technology increased. A number of factors may have contributed to this movement. This particular subject had difficulty becoming a self-sufficient publisher; she also consistently avoided two of the six word processors and the four she desired were not always available. Again, this trend was subject-specific, dependent upon individual personality.

Influence of Computer Environment Attributes

Of the following six findings, the ones of most importance are those related to the printer. The other three findings -- choice of word processor, choice of screen, and letter preference -- provide teachers with an insight into the use of computers with young children.

Choice of Monitor Screen Format. Once data were analyzed it became obvious that two of the subjects preferred color displays while three indicated no preference. Monitor screen format appears to be subject-specific, dependent upon individual personality.

Choice/Avoidance of Word Processor. One subject initially displayed an obvious preference for a specific word processor. Others displayed no preference. Two subjects displayed avoidance behaviors towards two computers. This avoidance was not of the same computers for each subject.

Discussion. Since the computers were situated in a 360 degree arrangement and located in one corner of the room, there was the potential for significant location-related variables. There were south-facing windows on one side of the learning center, two sides opened into the middle of the room, while the final side was aligned in front of a solid west wall. Peer and adult traffic patterns were also different for each side with the heaviest traffic around the open sides. With subtly different environmental factors associated with each of the computers, would children choose a specific word processor?

One subject displayed a preference for one machine until April 1. After that date, he began to use a variety of word processors. He was the only subject who displayed such a preference. However, two subjects avoided two computers. They avoided different computers. Their avoidance behaviors

were consistent throughout the data collection period. Regarding preference and avoidance of computers and the variety of variables which include distance to center of room, student and adult traffic patterns, amount and kind of light striking the screen, and screen display, each subject's computer choice was probably based on his/her own personality. The data do not explain why subjects selected one computer over another.

Use of Printer. There was an obvious desire by subjects to obtain a "hard copy" of their documents.

Print Output. Subjects printed their own text and often offered to print peers' text. It became apparent that they attempted to become self-sufficient in the printing process.

Printing Skills. Except for one subject, all subjects displayed self-sufficient printing behaviors by the end of the data collection period.

Discussion. From the beginning, subjects printed one or multiple copies of their documents every time they used a word processor. Not only did they print hard copies of their written documents, they often printed when playing or exploring the software. As knowledge of the "print screen" technique spread among the students, they began to use it to print their formatted documents. In addition, this same technique would be used when they explored software. They would find a specific screen in the edit mode and use "print screen" to produce a hard copy.

Students began using printers the first week they had an opportunity to use word processors. Initially, children were taken through the printing process both verbally and physically by an adult. Within a short time, often a matter of days, many children were being talked through the printing sequence as they physically manipulated the computer system themselves. By the end of January, within two weeks of computer access and use, one of the subjects was able to print a hard copy by himself.

All subjects displayed growth in their understanding and use of printers. All but one subject became self-sufficient at printing their documents by June. This one exception tried a number of times but appeared to have difficulty with the wholeness of the process, i.e., completing the software procedure at the computer and remembering to turn the network switch to the corresponding number of the computer she was using. She was often assisted by other students as peer assistance and sharing became a commonly observed sight in the word processor center. A second subject, while demonstrating self-sufficient printing, continued to rely on peer or adult assistance throughout the formal data collection period.

But why wasn't everyone able to print his/her own documents after five months of exposure to the process? Each child is an individual with his/her own knowledge, experience, and understanding which s/he brings to any given

situation. Although there was an age difference of seven months (Appendix J) between the two subjects who continued to seek assistance throughout the data collection period, they also appeared to be the least print literate of the five subjects. These two subjects who had minimum success as self-sufficient printers were the least print and technologically literate of the five subjects.

Letter Form Preference. Subjects displayed a variety of letter form preference in their writing.

Discussion. When using a word processor, young authors, unaware of English language letter conventions, have the opportunity to explore letter format options and to choose one they want to employ in their documents. It is easy, and subjects were observed to learn early in their contact with word processors, that pushing the caps lock key will result in all text being written in either upper or lower case letters. Subjects were also observed to learn early the use of shift keys. With this knowledge, subjects had the option to write in upper case, lower case, mixed case, or in conventional letter format.

When analyzing subjects' written products and graphing the data, it becomes obvious that some children have different letter format preferences. Of interest, only one subject used letters in a conventional manner. Generally, there was little mixing of upper and lower case letters. To a certain extent this may be a result of subjects' lack of

knowledge concerning conventional use of upper and lower case letters as well as not being forced by school personnel into the conventionalities of written language. As with so many other physical trends, preferences in use of letters may be a function of individual personality.

OUTHER FINDINGS

Keyboarding

Initially, subjects were often confused by the display of only upper case letters on the keyboards. This made it difficult for subjects to identify letters of the alphabet.

Discussion. Alphabetic symbols on computer keyboards are in upper case form which meant that subjects were forced to become aware that the standard English Language written alphabet consists of both upper and lower case letters (if they had not acquired this knowledge previously). When a child copied a word or letters--any text which was written in lower case letters--they had to remember and identify the upper case equivalent of that letter on the keyboard in order to write the lower case letter. For these blooming literates, copying and writing became an exercise in association. For some letters, such as X,x or K,k, such association is relatively easy. However, for certain letters, such as G,g or D,d, association is much more difficult. With certain letters the upper case keyboard symbols caused misunderstandings. The most troublesome

letter to associate for some children involved the I key. The IBM PCJr. keyboard, as well as Apple IIe and others, have the I key marked in such a manner, basically a straight line "I," that it is often interpreted as a lower case l. For young children, the sole use of upper case letters on keyboards can cause confusion and frustration as children search for letters. Brisk (1985) recorded similar findings.

An important component to successful movement, exploration, and play was identification of keys. Not only did children learn where keys were located on the QWERTY keyboard, they also learned to identify which keys would produce which symbols. These children no longer had to try to remember how to form specific letters or follow an involved fine motor procedure in order to write, they merely had to identify the correct key and push it. With the use of a word processor, certain writing skills and behaviors are modified and changed.

Key Rubbing

Subjects were often observed to rub their fingers back and forth across the keyboard -- not depressing keys, simply rubbing their fingers.

Discussion. Throughout the formal data collection period and also during preliminary research, children often rubbed their fingers across the keyboard when apparently in thought. This commonly took place when a child appeared

focused on a letter sound or a desired word. Also, children often exhibited this key rubbing behavior when they appeared focused on the next step in the printing procedure, how to clear a certain word from the screen, or how to move a letter back a few spaces. This rubbing of fingers on keys seems similar to the drumming of pencils and pens when writers use such artifacts.

CAI vs. Word Processing Software.

Subjects appeared to display a preference for the use of word processing software rather than CAI (Computer Assisted Instruction) software.

Discussion. Within the same writing lab as the word processor learning center was a CAI (Computer Assisted Instruction) learning center. Children were assigned to this center which focused upon a structured computer software program to teach phonics. There were times when children were interrupted from their writing with a word processor in order to participate in the CAI center. Children in the CAI setting sat before a programmed computer system and used one finger to push the correct key to recall the correct grapheme (letter) for a corresponding phoneme (sound) or correct graphemes for a requested word. The CAI software primarily used a stimulus-response approach to teaching phonics. As subjects became more proficient in their print and technological skills they were observed to resist the call to

stop their involvement in and control of the writing process in order to learn the phonemic make up of their written language from a stimulus-response teaching machine. Subjects and other children were observed to display a preference for word processing over that of CAI software.

Authorship of Word Processed Documents

It was common to observe that adults who worked in the study setting could identify authors of unidentified printed word processed documents.

Discussion. As previously mentioned, Brisk (1985) found that neither the computer nor printer revealed the real author. From a mechanical print perspective this is no doubt true, similar to the situation with typed or printed pages. Identification of unnamed papers by adults was a common activity in the writing lab. Printed documents without names were often found in the room. Classroom teachers and other school personnel assigned to the writing lab were generally able to determine the authors of unnamed documents. Compositions were usually identified by style or awareness of the author's topic.

Control

Subjects appeared to display a desire to, and did, control the word processor system.

Discussion. Subjects continued to explore print and technological literacy throughout the data collection period.

Once they learned how to depress keys, they were able to write letters or words. When a recognized mistake occurred, such as two letters pushed simultaneously or simply the wrong key chosen, one or two pushes of the backspace or delete key cleared the screen of the offending infraction. It was commonly observed that when their first line wrapped, following word automatically moved to the next line, a young writer would try to move the word back up the screen to the line above. Later, when they were able to produce a lot of text and it was scrolled a few lines off the top of the screen in order to make room at the bottom for additional text, children would often inquire about their missing letters and words. Also, subjects discovered early in their word processor experiences that if the cursor were put to the left of a word, that word and all text to the right or below could be moved all around the screen, up, down, left or right by using the backspace, delete, arrow, or return keys.

Along with the ease of writing came the ease of text screen creativity. As subjects moved their letters, words, and document about the screen, they were able to input spaces and easily separate letters, words, and lines. Subjects could easily arrange and format text in the manner they desired. If a child had not learned the convention of one space between words, that child would commonly create his/her own space conventions. It was observed in both preliminary and formal data collection periods that this ease of movement

and unawareness of a space convention allowed subjects to invent systems for separating words. Not unlike childrens play with oral language previously documented (Inhelder in Piattelli-Palmarini, 1980), as subjects continued to use, play, explore, and learn with print and technology, they reinvented and discovered the conventional single space between words of English written language.

Associated with behaviors of play and exploration is the concept of risk taking. Similar to Phenix and Hannan's (1984) findings, the inherent manipulative characteristics of a computer with word processing software supported subjects in their freedom to take risk. This is an extremely important finding in light of Harste's et al. (1984) findings: "... it is via the process of risk-taking that language learning and, hence, growth in literacy occurs" (p. 136). It became easy for a subject to try a letter, word, or space, experiment and play, then clear the screen if the desired outcome was not achieved. Subjects also had freedom to move words and letters around the screen and change their text format or design if desired. Risk taking became part of each subject's writing repertoire as their literacy of technology matured. The freedom to take risk with a word processor allowed subjects --

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Publicness

Subjects often looked at and read text on others' screens and others often looked at and read text on subjects' screens. This publicness commonly led to verbal interactions and an exchange of knowledge.

Discussion. When documents are produced, either on screens or hard copies, the text is of standard letter forms which can easily be read by children. Documents produced with standard letter forms are easier to read than handwritten documents. This easy-to-read aspect of computer-related text assisted in the promotion of word-processed documents becoming public. Subjects commonly stood in front of one another's screens and read text or asked and shared copies with their literary colleagues. This publicness supported and led to cooperative behaviors such as sharing, assisting, and volunteering. These cooperative behaviors and the ease of reading standard letter form text,

also led to collegial composing as subjects wrote documents with their peers, sharing words and ideas.

Meta-Linguistics

Verbal Interactions. Subjects often communicated verbally with peers and adults. Conversations commonly focused on print or technological issues. Meta-linguistic behaviors (use of language to talk about language) were commonly observed.

Sharing of Knowledge. It was common to observe children share their knowledge. Subjects commonly shared their knowledge of print literacy and the literacy of technology.

Working With Others. Subjects were often observed to share knowledge with others and work together to solve problems. These cooperative behaviors were commonly observed while subjects worked with both peers and adults.

Discussion. Sharing was not limited to the exchange of documents, written language information, or reading text on another's monitor screen. There were daily requests for help, volunteered assistance, and verbal sharing and dialogue among pairs and groups of children. Such sharing included discussions related to both print literacy and literacy of technology. There were various questions, e.g., location of certain keys, what letter represents a certain sound, how did you make that happen, how do you spell _____, how did you print that, what's your story about, and many more.

Meta-linguistics became a common practice as subjects were observed to share and discuss various aspects of print literacy and literacy of technology.

Throughout this study, subjects continued to evolve along their print literacy and literacy of technology continuums. Incorporated in this typical kindergarten's curriculum were various print literacy activities which occurred in the classroom. Characteristic large and small group kindergarten classroom activities included reading to children, singing songs and doing finger plays, exploring with manipulatives and art materials, experimenting and discussing science and social study topics.

Direct group teacher instruction covering print literacy or literacy of technology-related behaviors and skills was not observed in the writing lab during the data collection period. Throughout the lab, each learning center provided various print and/or technological literacy opportunities. Although these children did not receive large group direct instruction in the writing lab, their need for knowledge was facilitated through contact with various adults present in the lab. As previously described, adults introduced the printing process to children in the writing lab. If a child needed assistance with written language or the technology, they requested assistance from an adult. In a matter of a few weeks, peers also became facilitators and conduits of knowledge. Rather than teachers overwhelming students with

extraneous knowledge, children rediscovered and reinvented a great deal themselves which they shared with their peers. Generally, subjects received assistance from adults and their peers only as they required and requested it.

Information Age Etiquette

Subjects learned to check with others before clearing a text screen or printing their documents.

Discussion. In this research setting, where children often had opportunities to choose from a group of word processors, there were incidents of children learning Information Age etiquette. Since computers were networked three to a printer, as children learned the printing process they also learned the etiquette of checking to see if anyone else was in the process of printing. Another social etiquette behavior which children acquired consisted of checking with others when no one was at a computer but text was on the screen. In a setting where there were a number of people using a lesser number of computers, it became necessary to check with others in order to determine the availability of computers. Through social interactions with this limited-access Information Age tool, children were forced into new ways of thinking.

Cognition

Cognitive considerations related to print literacy and literacy of technology were observed throughout this investigation.

In addition to the social etiquette induced ways of thinking, other related trends were also identified. Along with key rubbing episodes, previously explained, it became common to observe children who appeared to be in thought. At times, this apparent thought became shared thinking and discussion. If one child had a problem and requested assistance, others would gather around and, in concert, attempt to solve the problem. Thinking and shared problem solving were observed to be important components in subject's evolution of print literacy and literacy of technology.

Problem Solving. Subjects commonly solved or attempted to solve their individual written language and technology problems. It was common to observe subjects attempting to solve peer problems or vice versa.

Discussion. Two forms of problem solving were identified -- one concerns print and the other technology. The one concerning print refers to those cognitive processes a subject employed when s/he ran into difficulty with a word or sound. The subject would often attempt to play with the sounds or words. This was commonly observed and recorded under the subject's "Self Talk." A subject might also ask a peer or an adult for assistance. The other area of problem

solving concerned associated equipment or, how to solve a technological problem? This occurred quite regularly as a result of the problem created when children reached across the top of a printer in order to tear off a sheet of paper. Often, when stretched across a printer, the child accidentally pushed one of the top buttons, effectively turning the printer off for everyone else. The next child to print had to figure out what to do. Generally, the next child to print did not run into difficulty until s/he had progressed to the final steps of the printing process and nothing happened. Here, as with print literacy problems, if subjects did not solve the problem themselves they would often request assistance from a peer or an adult. Subjects shared problem solving.

Thinking about Writing Tools. New ways of thinking related to the evolutionary intertwining of print literacy and literacy of technology developed.

Discussion. As subjects became more aware of the tool's capabilities, their understanding of its utilization in their writing changed. Subjects were inventing and rediscovering new print and technological thoughts. The following few examples are new ways of thinking about written language when using a word processor. Following their initial exposure to word processors, subjects rediscovered the English written language convention of space between words. When utilizing Industrial Age writing implements and those of previous

literate Ages, writers leave spaces as they write. In using word processors, subjects learned to physically input a space with a key stroke. Subjects also learned to print a hard copy of their ephemeral text. They discovered that light on a monitor screen was something they could not smudge, although they often touched the screen as they reread their documents. Subjects also discovered the malleability of word processor documents as they moved text around a screen. In time, they developed a degree of realization that they had many opportunities to place text in a variety of different locations. By the end of the data collection period, subjects had learned that their screen text could be saved on a disk and retrieved at another time for further writing.

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An outgrowth of young children using these Information Age machines was their learning and cognitive understandings of software, computers, and printing. For example, during one of his opportunities to print one subject followed a "To Clear" teacher-made direction card and cleared his text instead of printing it. This subject, at the young age of

six, was learning the importance of manipulating software correctly in order to produce a hard copy of his document. Developing an understanding and appreciation for cautious computer manipulation as a young child is cognitively important for members of the Information Age. Losing a two line story at age six allows a young child the opportunity to acquire an awareness of technology early in life so that later, when s/he is working on a major paper or important project, s/he does not accidentally erase or lose an entire document. Experiences such as these may allow young children of the Information Age to mature with a cognitive understanding that computers are helpful tools and machines which they can control and need not fear.

Often, while observing subjects writing, there was an apparent sense of total involvement in the word processor center. Not only were both hands involved in a physical sense, so were eyes, ears, and mouths as subjects shared, assisted, and talked to themselves and others during the writing process. It appeared that cognitively, subjects were not only involved in recall of information, they were also applying, analyzing, synthesizing, and evaluating their work. While writing, subjects constantly reread their text, wrote or sounded out the next word, figured out where they were, what they were doing, and where they were going, continuing to use many sophisticated cognitive behaviors as they wrote.

During this study, subjects were observed to mature along individual print literacy and literacy of technology continuums. Subjects' print and technological abilities and skills became more sophisticated as they interacted with peers and adults within the writing lab environment. Among the many findings are those which support the concept that young children, using word processors, are becoming cognitively prepared for the Information Age.

Printing. Printing is apparently another important cognitive process when writing with a word processor.

Discussion. In time, subjects learned two methods for producing a hard copy of their text. They first learned the previously explained normal software-controlled process. The second learned and easier method is the computer-controlled "print screen" technique. The first method produced documents in the manner in which they were written. If an author used the space bar, backspace, and arrow keys when manipulating cursor and text, the hard copy document often appeared quite different from the screen-displayed text. In order to obtain a formatted copy as originally written, designed, and screen displayed, it was necessary to use the "print screen" method. If using "print screen," the hard copy also included extraneous text of the software screen display. By the end of the data collection period, subjects knew of two printing methods and chose between them when producing a hard copy.

Neither of these printing methods required subjects to understand how light images moved from a monitor screen to become ink dots on paper at a printer. However, in order to work the computer printing system, subjects had to understand that these computers were networked with printers and that a dial at a switch box had to be turned, linking printer and computer, in order to successfully print one's text. Once the dial was turned, then a printing method could be initiated and the process completed.

No matter which printing method was employed, subjects always printed a hard copy of their prose. Printing was not limited to one copy but often entailed multiple copies which were shared with peers, adults, and family members. When asked, or as a result of their own initiative, children would share their printed prose by reading it aloud to others. The opportunity to print their work was an important feature of the word processor center.

Keyboarding. Another cognitive and kinesthetic consideration relates to the effective use of a word processor keyboard.

Discussion. Often, subjects appeared to naturally attempt to employ both hands in their play and writing. No doubt, some use of "both hands behavior" was an imitation of others they had seen write with a two handed writing device. Subjects were observed numerous times to use their right hand on the right side of the keyboard and their left hand on the

left side. Some subjects appeared extremely intent at keeping both hands on either side of a keyboard as they wrote. In addition some subjects, both in the preliminary and formal research, were observed attempting to invent or discover a "home row keys" method. This use of both hands and all fingers is cognitively and kinesthetically a new understanding for these young children who in the recent past have evolved a handedness and employed it for writing with a pencil and paper system.

Gender Differences

Subjects represented both genders in this study. The only apparent difference between the genders during the formal data collection period was their previously mentioned segmentation as they continued to evolve along their print literacy and literacy of technology continuums.

Discussion. Although no significant gender differences occurred during the formal research period, one of interest took place during the preliminary investigation. Observations were conducted in two kindergarten classes during the preliminary investigation. In the fourth month of the preliminary research it was discovered that all students who could print on their own, except for one, were boys. After analyzing this phenomenon, it was determined that this situation had unintentionally evolved. As girls finished their documents, they would generally continue to sit at the

computers, raise a hand, and wait for an adult to print their document for them. Meanwhile, many boys had been following the printing process since the first day. Watching and listening, they learned the printing process and took control of the equipment. When finished writing, boys would automatically print their own documents and work with anyone else who required their assistance.

Within the confines of the word processor center environment, there were no apparent reasons for this gender disparity in the operation of printers. Even though one of the kindergarten teachers was an ardent feminist, there were many cumulative social variables within our culture affecting the development of her students during their first five years of life. In addition, the necessity is apparent that educators continue to observe and evaluate their work with children and the educational environment.

During the formal data collection period of this investigation, educators working with children in the writing lab were aware of the previous year's gender differences. Once aware of the gender differences, personnel made a conscious commitment to include girls in the printing process. No doubt due to this awareness and the commitment exhibited by personnel, obvious gender differences did not reveal themselves as they had the previous year.

CONCLUSIONS

In western societies, young children of the late 20th century experience daily contact with tools of the Information Age. For educators, this investigation provides a foundation of empirical knowledge for curriculum and instruction of the Information Age. There were a number of conclusions drawn from the findings of this investigation. However, certain conclusions are more noteworthy than others for school decision makers. These distinctive conclusions can be separated into two categories related to school administration, management decisions, and curriculum and instruction decisions. Of these conclusions, a number fit both categories.

Educational decision makers will find it valuable to study the findings of this research along with the findings of psychologist and others investigating the concept of "locus of control." The young subjects of this investigation had the opportunity to control a tool of the Information Age through their use of word processing software. It was common to observe that children prefer the opportunity to work and play with (control) a word processor rather than responding to the dictates (control) of a computer programmed with CAI software. This is of particular importance in regard to many educators' and others' expectations for low socioeconomic students and young children.

Associated with the placement, status, and purchase of computers and software in education is the finding that print literacy and the literacy of technology evolved simultaneously. Language arts and computer literacy may not require the expenditure of funds for separate subject tools and resource materials. Computers are tools of and for literacy as pens and pencils have been in previous ages. In addition, although there are new ways of viewing the printed word, it was found that paper was an integral and important aspect of the use of a word processor. It was found that children could both control a computer system to print a hard copy of their writing and that they apparently desired a printout.

This study supports the theory of individualized evolution of print literacy. Each subject displayed a continuum of developmental literacy behaviors. As subjects acquired more sophisticated behaviors they continued to also employ earlier learned behaviors. This recycling of behaviors occurred with both print literacy and literacy of technology behaviors. Subjects were observed to intertwine and integrate these two forms of literacy as they used word processors. In addition, each subject was observed to evolve within his/her own time frame. In relation to the emphasis on wholistic learning and individualized instruction during recent years, these findings demonstrate that tools of the

Information Age (microcomputers) can support these educational concepts as readily as Industrial Age tools.

Whereas writing was generally a private act in previous ages, this study demonstrates the Information Age phenomenon of "publicness." Children commonly looked at one another's monitor screens and commented on each other's writing. This writing/reading connection often led to metalinguistic behaviors as children discussed print literacy issues or issues of technology and solved associated problems. These social and intellectual interchanges and problem-solving behaviors were not limited to opportunities growing from publicness, but at times grew out of collegial discussion initiated by one child seeking assistance from others. An additional outgrowth of these discussions was the learning of Information Age etiquette. Findings of this study demonstrate that the social interchange of information among students and staff may be an inherent aspect of computer systems where allowed to occur.

All of these findings point to the conclusion that in a print and technology-laden society, young children evolve an understanding of print literacy and literacy of technology. It is important that educators recognize this common form of cultural evolution and facilitate its growth through appropriate administrative, instructional, and curricular decisions.

The following are specific conclusions.

Young Children Are Capable Of Using A Word Processor

Young children are capable of learning to use and employing a word processor in their writing. As they use a word processor their print literacy as well as literacy of technology continues to mature.

Young Children Can Control A Word Processor

Young children desire to control the computer system. They want to become self-sufficient at printing and take control as soon as possible. This sense of control is also observed in children's writing process and their printed documents.

Young Children Practice Social Interactions

Dispelling the fear of isolation related to childrens' use of computers, young children are often involved with others when using a word processor or when a word processor is in the immediate environment. Their dialogue commonly focuses on print literacy or literacy of technology. Young children's social behaviors often encompass physical as well as verbal assistance to their peers, commonly through the sharing of print and technological knowledge.

Young Children Are Problem Solvers

Young children commonly solve or attempt to solve questions of written language and technology problems.

Young Children Are Learning Information Age Etiquette

Young children can learn to take turns in order to print in a computer network system. They are also learning to ask if others are finished with a computer if text is on the screen before using a particular computer.

Provide Printers

Where word processing will be an integral component in the design of computer use in schools, it is important to include printers in the computer system.

Modify Computer Keyboards

Initially, young children have difficulty with a typical "QWERTY" keyboard. Consider the inclusion of upper and lower case letters on the keys of computer keyboards used by young children.

Educators' Awareness

It is important that educators, including those in administration, be aware of children's knowledge of the Information Age and their utilization of associated tools. This awareness is particularly important in planning for the present and future education of our nation's children.

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APPENDIX A
EXAMPLES OF DATA RECORDING INSTRUMENTS

Monthly Report

Month _____

Check days children observed:

Children	Monday	Tuesday	Wednesday	Thursday	Friday
Alissa					
Eshell					
Joel					
Justin					
Lauren					
Rian					

Week of _____

Alissa					
Eshell					
Joel					
Justin					
Lauren					
Rian					

Week of _____

Alissa					
Eshell					
Joel					
Justin					
Lauren					
Rian					

Week of _____

Alissa					
Eshell					
Joel					
Justin					
Lauren					
Rian					

Week of _____

Alissa					
Eshell					
Joel					
Justin					
Lauren					
Rian					

Week of _____

Alissa					
Eshell					
Joel					
Justin					
Lauren					
Rian					

Daily Case Study Group Data Collection Week of _____

Day _____	Date _____						
Subject	WP used	Choice	B T	E T	T T	Activity	Comments

Day _____	Date _____						
Subject	WP used	Choice	B T	E T	T T	Activity	Comments

Day _____	Date _____						
Subject	WP used	Choice	B T	E T	T T	Activity	Comments

Day _____	Date _____						
Subject	WP used	Choice	B T	E T	T T	Activity	Comments

Day _____	Date _____						
Subject	WP used	Choice	B T	E T	T T	Activity	Comments

Name: _____ Date: _____ Time: B _____ E _____

Daily Case Study Data Collection Form

Special Activities: Y N _____

WP Used: Blue 1 2 3 Green 1 2 3 Color B & W

Choice

___ Right ___ Left ___ Both ___ Mix _____

___ Banger ___ Moderate ___ Easy ___ Mix _____

Ability to find keys: ___ Hard ___ Moderate ___ Easy ___ Play Typing

Keyboard Location: ___ Table ___ Lap ___ Other _____

Touching: ___ keyboard ___ screen ___ paper

Body Position: ___ sitting ___ standing ___ sitting/standing

5 Min.	Behavior	Comments
1		
2		
3		
4		

5

--

6

--

Publishing:

___ # of copies Shared with (list) _____

Printing: by self by peer with peer by adult with
adult

Teacher Comments:

APPENDIX B
EXAMPLES OF DATA ANALYSIS INSTRUMENTS

Student's Name _____ Month or s _____

Literacy Development Chart

[illegible][illegible]

Name _____ Month or s _____

Publishing Chart

BY	WITH	
Date	self	peer
adult	peer	adult
#	Shared	With

[illegible]

	BY	WITH	
Date	self	peer	adult
peer	adult	peer	adult
#			
Shared			
With			

[illegible]

APPENDIX C
SUBJECTS' INDIVIDUAL LITERACY DEVELOPMENT
DATA BASE

File: Martha Lit Data

Page 1

Report: Analysis

Date	Ply	Xpl	Nam	Alph	#	Wrd	Phrs	Snt	Stry	Nam	Alph	#	Wrd	Phrs	Snt	Stry
------	-----	-----	-----	------	---	-----	------	-----	------	-----	------	---	-----	------	-----	------

Date	Observed	Simulated	cdf	Observed	Simulated
Jan 14		x		x	
Jan 21				x	x
Jan 22	x		x	x	
Jan 26	x		x	x	x
Jan 27	x			x	x
Feb 10			x	x	x
Feb 12			x	x	x
Feb 18			x	x	x
Feb 20		x	x	x	x x
Feb 23			x	x	
Feb 24			x	x	x
Feb 28			x	x	x
Mar 3	x	x		x	x x
Mar 4		x	x	x	x
Mar 10					
Mar 16	x	x	x	x	x
Mar 18				x	
Mar 19					x x
Mar 30	x				x x
Apr 2					
Apr 8					
Apr 10	x				
Apr 16				x	
Apr 21	x		x		x x
Apr 28					
Apr 28				x	
Apr 29					
Apr 30					
May 6	x				
May 12					
May 18					
May 19		x			
May 21		x			
May 26	x	x			
May 27	x				
Jun 2				x	

File: Christy Lit Data

Page 1

Report: Analysis

Date	Ply	Xpl	Nam	Alph	#	Wrd	Phrs	Snt	Sty	Nam	Alph	#	Wrd	Phrs	Snt	Sty
------	-----	-----	-----	------	---	-----	------	-----	-----	-----	------	---	-----	------	-----	-----

[illegible]

File: Dave Lit Data

Page 1

Report: Analysis

Date	Ply	Xpl	Nam	Alph	#	Wrd	Phrs	Snt	Stry	Nam	Alph	#	Wrd	Phrs	Snt	Stry
Jan 13			x			cat				x						
Jan 14						cat				x			x			
Jan 20	x									x			x			
Jan 21			x							x			x			
Jan 22	x									x			x			
Jan 27	x	x								x	x		x			
Jan 29	x					x				x	x		x			
Feb 4	x	x				x				x	x		x			
Feb 11						x				x			x			
Feb 17						x				x			x			
Feb 17						x				x			x			
Feb 23						x							x			
Feb 26										x			x			
Mar 3						x				x			x			
Mar 11														x	x	x
Mar 17	x	x				x							x			
Mar 19	x	x				x							x			
Mar 31						x							x			
Apr 1	x	x				x							x			
Apr 2																x
Apr 8																x
Apr 22																x
Apr 23																x
Apr 29																x
May 5						x							x			
May 6			x			x										
May 7	x					x							x	x		
May 11	x	x														
May 12	x										x		x			
May 13	x												x			
May 19	x	x														
May 21	x	x														
May 22	x	x														
May 27	x	x				x					x	x	x	x		

File: Rachel Lit Data

Page 1

Report: Analysis

Date	Ply	Xpl	Nam	Alph	#	Wrd	Phrs	Snt	Stry	Nam	Alph	#	Wrd	Phrs	Snt	Stry
Jan 14						cat				x						
Jan 21						x				x						
Feb 2						x				x			x			
Feb 3						x				x			x			
Feb 9						x				x						
Feb 12						x				x			x			
Feb 18						x				x			x			
Feb 19						x				x			x			
Feb 26						x				x			x			
Mar 3						x				x			x			
Mar 4						x				x			x			
Mar 12						x				x			x			
Mar 17						x				x			x			
Mar 19						x				x			x			
Mar 30						x				x			x			x
Apr 1						x										x
Apr 6								x		x						
Apr 16																x
Apr 27										x			x			x
Apr 30														x		x
May 12																x
May 22										x			x			x
Jun 2						x				x						x

File: Mark Lit Data

Page 1

Report: Analysis

Date	Ply	Xpl	Nam	Alph	#	Wrd	Phrs	Snt	Stry	Nam	Alph	#	Wrd	Phrs	Snt	Stry
Jan 12	x			x	x	cat				x						
Jan 22	x															
Jan 26						x				x						
Jan 27						x										
Feb 2																
Feb 3	x	x														
Feb 9		x				x				x						
Feb 11						x				x						
Feb 17						x				x						
Feb 26						x				x			x			
Mar 11						x				x						
Mar 12						x				x			x			
Mar 19	x					x				x			x			
Mar 30						x				x					x	
Apr 10										x			x		x	
Apr 16	x														x	
Apr 20						x								x	x	x
May 4	x															x
May 14						x				x						
May 18	x	x				x										
May 26	x					x							x			

APPENDIX D
SUBJECTS' INDIVIDUAL QUALITATIVE COLLAPSED DATA

35						
34						
33						
32						
31						
30						
29	X			X	X	X
28	X	X		X		X
27		X	X	X	X	
26	X	X		X	X	
25	X	X		X		X
24	X	X		X		
23	X	X		X		X
22	X	X		X	X	X
21	X	X	X	X	X	X
20	X	X	X	X	X	X
19	X	X	X	X		X
18	X	X		X		
17	X	X		X	X	
16	X	X		X	X	
15	X	X		X	X	
14	X	X	X		X	
13	X		X	X	X	
12	X	X	X		X	
11	X	X		X		X
10	X	X			X	
9	X	X	X		X	
8	X	X			X	
7	X	X			X	
6	X	X	X	X	X	X
5	X	X	X	X	X	
4	X	X	X	X	X	X
3	X	X		X	X	X
2	X	X	X		X	X
1	X	X	X	X	X	

Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Martha's frequency of print and technological literacy associated behaviors with each opportunity to use a word processor.

days						
29						
28	X					
27	X	X				
26	X	X				
25	X	X				
24	X	X				
23	X	X				
22	X	X			X	
21	X	X			X	
20	X	X			X	
19	X	X			X	
18	X	X		X	X	
17	X	X		X	X	
16	X	X		X	X	
15	X	X		X	X	
14	X	X		X	X	
13	X	X	X	X	X	X
12	X	X	X		X	X
11	X	X	X	X	X	X
10	X	X	X	X	X	X
9	X	X	X	X	X	X
8	X	X	X	X	X	X
7	X	X	X	X	X	X
6	X	X	X	X	X	X
5	X	X	X	X	X	X
4	X	X	X	X	X	X
3	X	X	X	X	X	X
2	X	X	X	X	X	X
1	X	X	X	X	X	X
97%	93%	45%	38%	62%	76%	45%
Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

 Frequencies and percentages of Martha's print and technological literacy behaviors with each opportunity to use a word processor. N = 29

35							
34							
33							
32							
31							
30							
29							
28							
27							
26							
25							
24							
23							
22	X	X			X	X	
21	X	X	X			X	
20	X			X	X	X	
19	X	X	X	X		X	
18	X	X		X			
17	X				X		
16	X	X			X	X	
15	X	X		X	X	X	
14	X	X		X	X	X	
13	X			X	X	X	
12	X	X		X	X	X	
11	X	X	X	X	X		X
10	X	X		X		X	
9	X	X	X	X	X		X
8	X	X				X	X
7	X	X	X	X		X	
6	X	X	X	X	X	X	
5	X	X			X	X	X
4	X	X				X	X
3	X	X		X	X		
2	X	X	X	X			
1	X	X	X	X	X	X	X

Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Christy's frequency of print and technological literacy associated behaviors with each opportunity to use a word processor.

days						
22	X					
21	X					
20	X					
19	X	X				
18	X	X				
17	X	X				
16	X	X			X	
15	X	X		X	X	
14	X	X		X	X	
13	X	X		X	X	
12	X	X		X	X	
11	X	X		X	X	
10	X	X		X	X	
9	X	X		X	X	
8	X	X	X	X	X	
7	X	X	X	X	X	
6	X	X	X	X	X	X
5	X	X	X	X	X	X
4	X	X	X	X	X	X
3	X	X	X	X	X	X
2	X	X	X	X	X	X
1	X	X	X	X	X	X
100%	86%	38%	68%	64%	73%	27%
Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Frequencies and percentages of Christy's print and technological literacy behaviors with each opportunity to use a word processor. N = 22

35							
34							
33							
32							
31	X	X	X	X	X	X	
30	X	X	X	X	X	X	
29	X	X		X	X	X	
28	X	X	X	X		X	
27		X	X	X		X	
26		X	X	X		X	
25	X	X	X	X		X	
24	X	X		X		X	
23	X	X	X	X	X	X	X
22	X	X	X	X	X	X	X
21	X	X	X	X	X	X	
20	X	X	X	X	X	X	
19	X	X	X	X	X	X	X
18	X	X	X	X	X	X	X
17	X	X	X		X		X
16	X	X			X	X	X
15	X	X		X		X	
14	X	X	X	X		X	
13	X	X	X	X		X	
12	X	X	X				X
11	X	X		X	X	X	X
10	X	X	X		X	X	X
9	X	X	X	X	X	X	
8	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X
6	X	X			X	X	X
5	X	X	X	X	X	X	X
4	X		X	X	X	X	X
3	X		X	X	X	X	X
2	X	X			X	X	X
1	X	X		X	X	X	X

Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Dave's frequency of print and technological literacy associated behaviors with each opportunity to use a word processor. Dave

days						
31						
30						
29	X	X			X	
28	X	X			X	
27	X	X			X	
26	X	X			X	
25	X	X		X	X	
24	X	X		X	X	
23	X	X	X	X	X	
22	X	X	X	X	X	
21	X	X	X	X	X	
20	X	X	X	X	X	
19	X	X	X	X	X	
18	X	X	X	X	X	
17	X	X	X	X	X	X
16	X	X	X	X	X	X
15	X	X	X	X	X	X
14	X	X	X	X	X	X
13	X	X	X	X	X	X
12	X	X	X	X	X	X
11	X	X	X	X	X	X
10	X	X	X	X	X	X
9	X	X	X	X	X	X
8	X	X	X	X	X	X
7	X	X	X	X	X	X
6	X	X	X	X	X	X
5	X	X	X	X	X	X
4	X	X	X	X	X	X
3	X	X	X	X	X	X
2	X	X	X	X	X	X
1	X	X	X	X	X	X
	94%	94%	74%	81%	71%	94%
	Print	Tech-	Mix Tech-	Social	Print	Tech.
		nology	nologies		Social	Social
						Talk

Frequencies and percentages of Dave's print and technological literacy behaviors with each opportunity to use a word processor. N = 31

35						
34						
33						
32						
31						
30						
29						
28						
27						
26						
25						
24						
23						
22						
21						
20	X		X		X	
19	X	X	X			
18	X	X	X		X	
17	X	X		X		
16	X	X			X	X
15	X				X	X
14	X	X			X	X
13	X	X		X	X	X
12	X	X	X			X
11	X	X				X
10	X					X
9	X			X		X
8	X	X	X			X
7	X	X		X		X
6	X	X	X		X	X
5	X	X				X
4	X	X	X			X
3	X		X			X
2	X	X		X		X
1	X	X	X	X		

Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Rachel's frequency of print and technological literacy associated behaviors with each opportunity to use a word processor.

days							
20	X						
19	X						
18	X						
17	X						
16	X						
15	X	X				X	
14	X	X				X	
13	X	X				X	
12	X	X				X	
11	X	X				X	
10	X	X				X	
9	X	X	X			X	
8	X	X	X			X	
7	X	X	X		X	X	
6	X	X	X	X	X	X	
5	X	X	X	X	X	X	
4	X	X	X	X	X	X	
3	X	X	X	X	X	X	
2	X	X	X	X	X	X	
1	X	X	X	X	X	X	
100%	75%	45%	30%	35%	75%	0%	
Print	Tech-	Mix Tech-	Social	Print	Tech.	Self	
	nology	nologies		Social	Social	Talk	

 Frequencies and percentages of Rachel's print and technological literacy behaviors with each opportunity to use a word processor. N = 20

35							
34							
33							
32							
31							
30							
29							
28							
27							
26							
25							
24							
23							
22							
21	X	X	X	X	X	X	X
20	X		X	X	X	X	
19	X	X	X	X		X	
18	X	X		X		X	
17	X	X	X	X	X	X	
16	X	X	X	X	X	X	X
15	X	X	X	X	X	X	
14	X			X	X	X	
13	X			X			
12	X		X		X	X	
11	X		X	X	X	X	
10	X		X		X	X	X
9	X	X		X	X	X	
8	X	X				X	
7	X	X	X	X		X	X
6	X	X			X	X	
5	X	X	X		X	X	X
4	X	X	X		X	X	
3	X	X	X		X		X
2	X	X	X		X	X	X
1	X	X	X	X	X	X	

Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Mark's frequency of print and technological literacy associated behaviors with each opportunity to use a word processor.

days						
21	X					
20	X					
19	X				X	
18	X				X	
17	X				X	
16	X			X	X	
15	X	X	X	X	X	
14	X	X	X	X	X	
13	X	X	X	X	X	
12	X	X	X	X	X	
11	X	X	X	X	X	
10	X	X	X	X	X	
9	X	X	X	X	X	
8	X	X	X	X	X	
7	X	X	X	X	X	X
6	X	X	X	X	X	X
5	X	X	X	X	X	X
4	X	X	X	X	X	X
3	X	X	X	X	X	X
2	X	X	X	X	X	X
1	X	X	X	X	X	X
100%	71%	71%	62%	76%	90%	33%
Print	Tech-	Mix Tech-	Social	Print	Tech.	Self
	nology	nologies		Social	Social	Talk

Frequencies and percentages of Mark's print and technological literacy behaviors with each opportunity to use a word processor. N = 21

APPENDIX E
SUBJECTS' TIME ANALYSIS SPREAD SHEETS

File:	Subject	Time
-------	---------	------

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Subject's Time On Task

Martha	Date	Time		Eshell	Date	Time
	1/15	11			1/13	19
	1/20	6			1/20	12
	1/21	7			1/22	27
	1/23	16			1/26	20
	1/26	13			1/27	20
	Total Time	53		Total Time		98
	Average	10.6		Average		19.6
Cumulative Average	10.6			Cumulative Average		19.6
	Date	Time			Date	Time
	2/4	9			2/10	25
	2/10	13			2/13	34
	2/12	6			2/18	23
	2/18	22			2/20	29
	2/20	24			2/26	19
	2/23	9				
	2/24	7				
	2/26	18				
	Total Time	108		Total Time		130
	Average	13.5		Average		26
Cumulative Average	12.05			Cumulative Average		22.8
Martha	Date	Time		Eshell	Date	Time
	3/3	8			3/10	20
	3/10	8			3/11	18
	3/16	10			3/12	21
	3/18	16			3/16	14
	3/20	12			3/18	12
	3/30	8			3/31	13
	Total Time	62		Total Time		98
	Average	10.33333		Average		16.33333
Cumulative Average	11.47777			Cumulative Average		20.64444

Martha	Date	Time		Christy	Date	Time	
	4/2	5			4/7	11	
	4/8	16			4/13	10	
	4/10	5			4/17	16	
	4/21	10			4/21	12	
	4/28	8			4/27	21	
	4/28	15			4/29	12	
	4/29	10					

Total Time	69		Total Time	82	
Average	9.8571429		Average	13.66666	
Cumulative Average	9.947619		Cumulative Average	18.65	
Date	Time		Date	Time	
5/6	10		5/1	7	
5/12	9		5/5	10	
5/18	14		5/19	13	
5/19	10				
5/21	31				
5/27	12				

File: Subject Time Page 2

Total Time	86		Total Time	30	
Average	14.33333		Average	10	
Cumulative Average	11.72476		Cumulative Average	17.12	
Martha Date	Time		Date	Time	
6/2	15			0	

Total Time	15		Total Time	0	
Average	15		Average	0	
Cumulative Average	12.27063		Cumualtive Average	14.26666	

Study's Total Time	393		Study's Total Time	438	
Total Time in Hour	6.55		Total Time in Hour	7.3	

Total minutes of study related observation time	2782
Total hours of study related observatiom time	46.36666

[illegible]

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Subject's Time On Task

Dave	Date	Time
	1/13	19
	1/14	13
	1/20	38
	1/21	13
	1/27	50
	1/29	27
Total Time		160
Average		26.66666
Cumulative Average		26.66666
	Date	Time
	2/4	38
	2/11	25
	2/17	47
	2/23	21
Total Time		131
Average		32.75
Cumulative Average		29.70833
Dave	Date	Time
	3/2	24
	3/3	49
	3/11	16
	3/17	23
	3/19	45
	3/31	12
# of Days Tot Time		169
Average		28.16666
Cumulative Average		29.19444

Rachel	Date	Time	1
	1/20	5	
	1/21	8	
	Total Time	13	
	Average	6.5	
Cumulative	Average	6.5	
	Date	Time	
	2/3	16	
	2/5	9	
	2/9	10	
	2/12	18	
	2/18	18	
	2/26	9	
	Total Time	80	
	Average	13.33333	
Cumulative	Average	9.9166667	
Rachel	Date	Time	
	3/3	10	
	3/4	10	
	3/9	6	
	3/12	8	
	3/17	13	
	3/19	10	
	3/30	7	
	Total Time	64	
	Average	9.1428571	
Cumulative	Average	9.6587302	

Dave	Date	Time	Rachel	Date	Time
	4/1	31		4/1	13
	4/8	25		4/6	8
	4/22	55		4/9	12
	4/23	57		4/16	8
	4/29	35		4/27	8
Total Time		203	Total Time		49
Average		40.6	Average		9.8
Cumulative Average		33.35833	Cumulative Average		10.36071
Date		Time	Date		Time
5/5		32	5/12		14
5/6		22	5/22		10
5/7		14			
5/11		24			
5/12		14			
5/13		6			
5/18		39			
5/21		26			
5/22		31			
5/26		55			
File:	Subject	Time			Page 2
	5/27	25			
Total Time		208	Total Time		24
Average		23.11111	Average		12
Cumulative Average		30.25888	Cumulative Average		10.15523
Dave	Date	Time	Rachel	Date	Time
	*6/2	13		6/2	12
	*6/3	37			
	*6/4	18			
Total Time		68	Total Time		12
Average		22.66666	Average		12
Cumulative Average		28.99351	Cumulative Average		10.46269
Studies Total Time		939	Studies Total Time		242
Total Time in Hour		15.65	Total Time in Hour		4.0333333

File: Subject Time Page 1

Subject's Time On Task

Mark	Date	Time
	1/12	19
	1/26	22
	1/27	10
Total Time		51
Average		17
Cumulative Average		17
Mark	Date	Time
	2/2	3
	2/9	17
	2/11	13
	2/17	19
	2/26	28
Total Time		80
Average		16
Cumulative Average		16.5
Mark	Date	Time
	3/11	19
	3/12	9
	3/19	17
	3/30	12
Total Time		57
Average		14.25
Cumulative Average		15.75

Mark	Date	Time
	4/10	15
	4/13	18
	4/16	18
	4/20	23
	4/28	11
Total Time		85
Average		17
Cumulative Average		12.8125
Mark	Date	Time
	5/4	44
	5/14	57
	5/18	29
	5/26	30

File: Subject Time

Page 2

Total Time		160
Average		40
Cumulative Average		20.85
Mark	Date	Time
	6/2	26
	6/3	35
	6/4	49
	6/5	61

Total Time		171
Average		42.75
Cumulative Average		24.5

Studies Total Time	604
Total Time in Hour	10.06666

APPENDIX F
RECONFIGURED TIME ANALYSIS DATA BASE

File: Time Analysis

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Report: Individual

Subject	Month	Total Time	Cumulative Time -	Average	Cumulative Average
Martha	1	53	53	11	11
Martha	2	108	161	14	12
Martha	3	62	223	10	12
Martha	4	69	292	10	10
Martha	5	86	378	14	12
Martha	6	15	393	15	12
Christy	1	98	98	20	20
Christy	2	130	228	26	23
Christy	3	98	326	16	21
Christy	4	82	408	14	19
Christy	5	30	438	10	17
Christy	6		438		17
Dave	1	160	160	27	27
Dave	2	131	291	33	30
Dave	3	169	460	28	29
Dave	4	203	663	41	33
Dave	5	208	871	23	30
Dave	6	68	939	23	29
Rachel	1	13	13	6	6
Rachel	2	80	93	13	10
Rachel	3	64	157	9	10
Rachel	4	49	206	10	10
Rachel	5	24	230	12	10
Rachel	6	12	242	12	10
Mark	1	51	51	17	17
Mark	2	80	131	16	16
Mark	3	57	188	14	16
Mark	4	85	273	17	13
Mark	5	160	433	40	21
Mark	6	171	604	43	24

File: Time Analysis

Page 1

Report: Month

Subject	Month	Total Time	Cumulative Time	-	Average	Cumulative Average
Martha	1	53	53		11	11
Christy	1	98	98		20	20
Dave	1	160	160		27	27
Rachel	1	13	13		6	6
Mark	1	51	51		17	17
Martha	2	108	161		14	12
Christy	2	130	228		26	23
Dave	2	131	291		33	30
Rachel	2	80	93		13	10
Mark	2	80	131		16	16
Martha	3	62	223		10	12
Christy	3	98	326		16	21
Dave	3	169	460		28	29
Rachel	3	64	157		9	10
Mark	3	57	188		14	16
Martha	4	69	292		10	10
Christy	4	82	408		14	19
Dave	4	203	663		41	33
Rachel	4	49	206		10	10
Mark	4	85	273		17	13
Martha	5	86	378		14	12
Christy	5	30	438		10	17
Dave	5	208	871		23	30
Rachel	5	24	230		12	10
Mark	5	160	433		40	21
Martha	6	15	393		15	12
Christy	6		438			17
Dave	6	68	939		23	29
Rachel	6	12	242		12	10
Mark	6	171	604		43	24

File: Time Analysis

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Report: Total Monthly Time

Subject Month Total Time Cumulative Time - Average Cumulative Average

Subject	Month	Total Time	Cumulative Time	Average	Cumulative Average
Christy	6		438		17
Rachel	6	12	242	12	10
Rachel	1	13	13	6	6
Martha	6	15	393	15	12
Rachel	5	24	230	12	10
Christy	5	30	438	10	17
Rachel	4	49	206	10	10
Mark	1	51	51	17	17
Martha	1	53	53	11	11
Mark	3	57	188	14	16
Martha	3	62	223	10	12
Rachel	3	64	157	9	10
Dave	6	68	939	23	29
Martha	4	69	292	10	10
Rachel	2	80	93	13	10
Mark	2	80	131	16	16
Christy	4	82	408	14	19
Mark	4	85	273	17	13
Martha	5	86	378	14	12
Christy	1	98	98	20	20
Christy	3	98	326	16	21
Martha	2	108	161	14	12
Christy	2	130	228	26	23
Dave	2	131	291	33	30
Dave	1	160	160	27	27
Mark	5	160	433	40	21
Dave	3	169	460	28	29
Mark	6	171	604	43	24
Dave	4	203	663	41	33
Dave	5	208	871	23	30

File: Time Analysis

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Report: Cumulative Monthly Time

Subject Month Total Time Cumulative Time - Average Cumulative Average

Subject	Month	Total Time	Cumulative Time	Average	Cumulative Average
Rachel	1	13	13	6	6
Mark	1	51	51	17	17
Martha	1	53	53	11	11
Rachel	2	80	93	13	10
Christy	1	98	98	20	20
Mark	2	80	131	16	16
Rachel	3	64	157	9	10
Dave	1	160	160	27	27
Martha	2	108	161	14	12
Mark	3	57	188	14	16
Rachel	4	49	206	10	10
Martha	3	62	223	10	12
Christy	2	130	228	26	23
Rachel	5	24	230	12	10
Rachel	6	12	242	12	10
Mark	4	85	273	17	13
Dave	2	131	291	33	30
Martha	4	69	292	10	10
Christy	3	98	326	16	21
Martha	5	86	378	14	12
Martha	6	15	393	15	12
Christy	4	82	408	14	19
Mark	5	160	433	40	21
Christy	6		438		17
Christy	5	30	438	10	17
Dave	3	169	460	28	29
Mark	6	171	604	43	24
Dave	4	203	663	41	33
Dave	5	208	871	23	30
Dave	6	68	939	23	29

File: Time Analysis

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Report: Monthly Average Time Per Session

Subject Month Total Time Cumulative Time - Average Cumulative Average

Christy	6		438		17
Rachel	1	13	13	6	6
Rachel	3	64	157	9	10
Rachel	4	49	206	10	10
Martha	4	69	292	10	10
Christy	5	30	438	10	17
Martha	3	62	223	10	12
Martha	1	53	53	11	11
Rachel	5	24	230	12	10
Rachel	6	12	242	12	10
Rachel	2	80	93	13	10
Martha	2	108	161	14	12
Christy	4	82	408	14	19
Mark	3	57	188	14	16
Martha	5	86	378	14	12
Martha	6	15	393	15	12
Mark	2	80	131	16	16
Christy	3	98	326	16	21
Mark	1	51	51	17	17
Mark	4	85	273	17	13
Christy	1	98	98	20	20
Dave	6	68	939	23	29
Dave	5	208	871	23	30
Christy	2	130	228	26	23
Dave	1	160	160	27	27
Dave	3	169	460	28	29
Dave	2	131	291	33	30
Mark	5	160	433	40	21
Dave	4	203	663	41	33
Mark	6	171	604	43	24

File: Time Analysis

Page 1

Report: Monthly Cumulative Average Per Session

Subject Month Total Time Cumulative Time - Average Cumulative Average

Subject	Month	Total Time	Cumulative Time	Average	Cumulative Average
Rachel	1	13	13	6	6
Rachel	3	64	157	9	10
Martha	4	69	292	10	10
Rachel	2	80	93	13	10
Rachel	5	24	230	12	10
Rachel	4	49	206	10	10
Rachel	6	12	242	12	10
Martha	1	53	53	11	11
Martha	3	62	223	10	12
Martha	5	86	378	14	12
Martha	2	108	161	14	12
Martha	6	15	393	15	12
Mark	4	85	273	17	13
Mark	3	57	188	14	16
Mark	2	80	131	16	16
Mark	1	51	51	17	17
Christy	6		438		17
Christy	5	30	438	10	17
Christy	4	82	408	14	19
Christy	1	98	98	20	20
Christy	3	98	326	16	21
Mark	5	160	433	40	21
Christy	2	130	228	26	23
Mark	6	171	604	43	24
Dave	1	160	160	27	27
Dave	6	68	939	23	29
Dave	3	169	460	28	29
Dave	2	131	291	33	30
Dave	5	208	871	23	30
Dave	4	203	663	41	33

APPENDIX G
SUBJECTS' INDIVIDUAL CHOICE DATA BASES

File: Martha Choice

Page 1

Report: Analysis

Date Blue 1 Blue 2 Blue 3 Green 1 Green 2 Green 3 B & W Color Choice

Date	Blue 1	Blue 2	Blue 3	Green 1	Green 2	Green 3	B & W	Color Choice
Jan 15					X		X	O
Jan 20					X		X	X
Jan 21		X					X	O
Jan 22		X					X	O
Jan 26	X						X	X
Jan 27					X		X	O
Feb 4		X					X	O
Feb 10	X						X	O
Feb 12		X					X	O
Feb 18				X			X	O
Feb 19					X		X	O
Feb 20						X	X	O
Feb 23	X						X	O
Feb 24						X	X	O
Feb 26						X	X	O
Mar 3				X			X	X
Mar 4					X		X	O
Mar 10				X			X	O
Mar 16						X	X	O
Mar 18			X				X	O
Mar 19				X			X	O
Mar 30					X		X	O
Apr 2	X						X	X
Apr 8		X					X	O
Apr 10		X					X	O
Apr 16				X			X	O
Apr 21				X			X	O
Apr 28						X	X	O
Apr 28						X	X	O
Apr 29			X				X	O
Apr 30						X	X	O
May 6					X		X	O
May 12			X				X	O
May 18				X			X	O
May 19	X						X	O
May 21						X	X	O
May 26				X			X	X
May 27			X				X	O
Jun 2		X					X	O

File: Dave Choice

Page 1

Report: Analysis

Date	Blue 1	Blue 2	Blue 3	Green 1	Green 2	Green 3	B & W	Color	Choice
Jan 13	x							x	o
Jan 14					x		x		o
Jan 20	x						x		o
Jan 21	x							x	o
Jan 22					x			x	x
Jan 27	x							x	o
Jan 29	x							x	o
Feb 4	x						x		x
Feb 11					x		x		o
Feb 17	x							x	o
Feb 17	x							x	o
Feb 18	x						x		o
Feb 23	x							x	o
Feb 26	x							x	o
Mar 3		x						x	o
Mar 11	x						x		o
Mar 17	x							x	o
Mar 18		x						x	o
Mar 31	x							x	o
Apr 1	x							x	o
Apr 2		x						x	o
Apr 8		x						x	o
Apr 22					x			x	o
Apr 23		x					x		x
Apr 27					x		x		x
Apr 29				x				x	x
Apr 29			x				x		x
May 5	x						x		o
May 6					x			x	o
May 7				x			x		x
May 11						x		x	o
May 12	x						x		o
May 13			x				x		o
May 19						x		x	
May 19			x				x		o
May 21				x			x		o
May 22		x					x		o
May 22						x	x		o
May 26		x						x	o
May 27				x			x		o
Jun 2				x				x	x
Jun 3	x							x	x
Jun 4					x		x		x

File: Rachel Choice

Page 1

Report: Analysis

Date Blue 1 Blue 2 Blue 3 Green 1 Green 2 Green 3 B & W Color Choice

Jan 14		x					x	o
Jan 20			x				x	o
Jan 21			x				x	o
Jan 29						x	x	o
Feb 2					x		x	o
Feb 3					x		x	o
Feb 9					x		x	o
Feb 12						x	x	x
Feb 18					x		x	o
Feb 19			x				x	o
Feb 26			x				x	o
Mar 3				x			x	o
Mar 4						x	x	o
Mar 12			x				x	o
Mar 17						x	x	o
Mar 19					x		x	o
Mar 30	x						x	o
Apr 1				x			x	o
Apr 6			x				x	o
Apr 9	x						x	o
Apr 16						x	x	o
Apr 27					x		x	o
Apr 30						x	x	o
May 12				x			x	o
May 22					x		x	o
Jun 2						x	x	o

File: Mark Choice

Page 1

Report: Analysis

Date Blue 1 Blue 2 Blue 3 Green 1 Green 2 Green 3 B & W Color Choice

Date	Blue 1	Blue 2	Blue 3	Green 1	Green 2	Green 3	B & W	Color Choice
Jan 12						x	x	x
Jan 22						x	x	x
Jan 26						x	x	o
Jan 27					x			o
Feb 2					x			o
Feb 3					x			o
Feb 9						x		o
Feb 11		x					x	o
Feb 17			x				x	o
Feb 26		x					x	o
Mar 4					x		x	o
Mar 11			x				x	o
Mar 12		x					x	o
Mar 19	x						x	o
Mar 30					x		x	o
Apr 10					x		x	o
Apr 13			x				x	o
Apr 16		x					x	o
Apr 20				x			x	o
Apr 28			x				x	o
May 4			x				x	o
May 14			x				x	o
May 14		x					x	o
May 18				x			x	o
May 26				x			x	o
Jun 2				x			x	o
Jun 3						x	x	o
Jun 4		x					x	o
Jun 5		x					x	o

APPENDIX H
SUBJECTS' INDIVIDUAL PRINTER DATA BASES

File: PubChart Martha

Page 1

Report: Analysis

Date by adult by peer with adult with peer by self # shared with

Date	by adult	by peer	with adult	with peer	by self	#	shared with
Jan 15	x					1	
Jan 21			x			1	
Jan 22	x					1	
Jan 26			x			1	
Jan 27	x					1	
Feb 4			x	x		1	
Feb 10			x			1	
Feb 12	x					1	moved to CAI
Feb 18					x	1	
Feb 20					x	1	
Feb 20					x	1	
Feb 23		x	x			2	
Feb 24					x	1	
Feb 26					x	1	
Mar 3					x	1	
Mar 4					x	1	
Mar 10					x	1	
Mar 16			x			1	
Mar 18					x	1	
Mar 19					x	1	print screen
Mar 30			x			1	
Apr 2		x				1	print screen
Apr 8			x			1	
Apr 10					x	1	
Apr 16					x	1	
Apr 21					x	1	
Apr 28					x	2	
Apr 28					x	1	copy for Kathy
Apr 28					x	2	2nd story
Apr 29					x	3	me, self, display
Apr 30					x	2	
May 6					x	1	
May 6			x			1	Hazel wanted one
May 12					x	1	grandma
May 18					x	1	
May 19					x	0	out of time
May 21			x	x		2-5	others
May 27					x	1	
Jun 2					x	1	

File: PubChart Christy

Page 1

Report: Analysis

Date by self by peer by adult with peer with adult # shared with

Jan 12			x			1	
Jan 20			x			1	
Jan 22			x			1	
Jan 22						x 1	
Jan 26						x 1	
Jan 27			x			1	
Feb 10				x		x 1	
Feb 13						x 1	
Feb 18				x		x 1	
Feb 20						x 1	
Feb 26				x		x 1	
Mar 10						x 1	
Mar 11						x 1	
Mar 12						x 1	
Mar 16						x 1	
Mar 17						x 1	
Mar 18				x		1	
Mar 30				x		1	
Mar 31						x 1	
Apr 7				x		1	
Apr 13				x		1	
Apr 17						x 1	
Apr 21				x		1	
Apr 27						x 1	
Apr 30						x 1	almost
May 1				x		x 1	
May 5						x 1	
May 13						x 1	
May 19						x 1	

File: PubChart Dave

Page 1

Report: Analysis

Date by adult by peer with adult with peer by self # shared with

Date	by adult	by peer	with adult	with peer	by self #	shared with
Jan 13			x		1	
Jan 14	x				1	
Jan 20			x		1	
Jan 21			x		1	
Jan 22	x				1	
Jan 27			x		1	
Jan 29					x 1	
Feb 4			x		1	
Feb 11					x 1	
Feb 17			x		1	
Feb 18					x 1	
Feb 23					x 1	
Mar 2					x 1	
Mar 3					x 6	in his home
Mar 11					x 1	
Mar 17					x 1	
Mar 19			x		1	print screen
Mar 26					x 1	
Mar 31			x		3	reg. prt scrn. me
Apr 1			x		5	prt scrn-friends
Apr 2					x 1	prt scrn, me
Apr 8					x 1	
Apr 22						saved
Apr 23			x		1	
Apr 29					x 0	*cleared*
May 5					x 2	1 mistake
May 6					x 1	print screen
May 7					x 1	print screen
May 11					x 1	print screen
May 11			x		2	prt scrn-files lis
May 12					x 2	me
May 13					x 1	
May 21					x 1-5	helping others
May 22					x 2	reg. prt scrn
May 26					x 1	received copy-Matt
May 27					x 1	
Jun 2						saved
Jun 3						saved
Jun 4						saved

File: PubChart Rachel

Page 1

Report: Analysis

Date by adult by peer with adult with peer by self # shared with

Date	by adult	by peer	with adult	with peer	by self #	shared with
Jan 14						choose not to prin
Jan 21			X		1	
Feb 2			X		1	
Feb 3			X		1	
Feb 9			X		1	
Feb 12			X		1	
Feb 18		X			1	
Feb 19			X		1	
Feb 26			X		1	
Mar 3			X		1	
Mar 4			X		1	
Mar 12			X	X	1	
Mar 17			X		1	
Mar 19			X		1	
Mar 30				X	1	
Apr 1			X		1	
Apr 6				X	1	
Apr 16					X 1	
Apr 27					X 1	
Apr 30					X 1	
May 2					X 1	
May 22					X 1	
Jun 2			X		1	computer problems

File: PubChart Mark

Page 1

Report: Analysis

Date	by self	by peer	by adult	with peer	with adult	#	shared with
Jan 12			x			1	
Jan 22			x			1	
Jan 23			x			1	
Jan 27			x			1	
Feb 3						0	choose not to
Feb 7				x		x 1	
Feb 11						x 1	
Feb 17				x		1	
Feb 26						x 1	
Mar 4						x 1	
Mar 11						x 1	
Mar 12						x 1	
Mar 19						x 1	
Mar 30						x 1	
Apr 10				x		x 1	
Apr 13				x		1	print screen
Apr 16				x		1	print screen
Apr 20	x					1	
May 4						x 2	1st he ripped
May 14	x					1	
May 18						0	moved to CAI
May 26		x				3	2 prt scrn, 1 edit
Jun 2			x				saved text
Jun 3			x				saved text
Jun 4			x				saved text
Jun 5	x					1	

APPENDIX I
SUBJECTS' INDIVIDUAL LETTER CHOICE DATA BASES

File: Letters Martha Page 1
 Report: Analysis
 Date Upper Lower Mixed Conventional Comments

Jan 15			1		
Jan 22			1		
Jan 21			1		
Jan 26			1		
Jan 27			1		mostly upper
Feb 4	1				
Feb 10					
Feb 12	1		1		mostly upper
Feb 18	1				
Feb 18		1			2nd one for date
Feb 20	1				
Feb 23	1				
Feb 24	1				
Feb 26	1				
Mar 3			1		
Mar 4			1		mostly lower
Mar 10		1			
Mar 16	1				
Mar 18		1			
Mar 19		1			
Mar 30	1				
Apr 2	1				
Apr 8		1			
Apr 10	1				
Apr 16		1			
Apr 21	1				
Apr 28	1				
Apr 28	1				2nd one for date
Apr 29	1				
Apr 30	1				
May 6	1				
May 12		1			
May 18		1			
May 27	1				
Jun 2		1			
Totals	18*	9*	8*		

File: Letters Christy

Page 1

Report: Analysis

Date Upper Lower Mixed Conventional Comments

Date	Upper	Lower	Mixed	Conventional	Comments
Jan			1		
Jan		1			
Jan			1		
Jan		1			
Jan		1			
Jan			1		
Feb		1			
Feb		1			
Feb			1		mostly upper
Feb		1			
Feb		1			
Feb		1			
Mar		1			
Mar		1			
Mar		1			
Mar		1			
Mar		1			
Mar	1				
Mar	1				
Mar	1				
Apr		1			
Apr		1			
Apr	1				
Apr		1			
Apr		1			
Apr	1				
May		1			
May	1				
May		1			
May		1			
May		1			
Totals	6*	21*	4*		

File: Letters Dave

Page 1

Report: Analysis

Date Upper Lower Mixed Conventional Comments

Date	Upper	Lower	Mixed	Conventional	Comments
Jan 13			1		
Jan 14			1		mostly upper
Jan 20			1		mostly upper
Jan 21			1		mostly upper
Jan 22			1		mostly upper
Jan 27	1				
Jan 29	1				
Feb 4	1				
Feb 11	1				
Feb 17	1				
Feb 18	1				
Feb 19	1				
Feb 26	1				
Mar 2	1				
Mar 3	1				
Mar 11	1				
Mar 17	1				
Mar 19	1				
Mar 31	1				
Apr 1	1				
Apr 2	1				
Apr 8	1				
Apr 22	1				
Apr 23	1				
May 5	1				
May 6	1				
May 7	1				
May 11	1				
May 12	1				
May 13	1				
May 22	1				
May 26	1				
May 27	1				
Totals	28*		5*		

File: Letters Rachel

Page 1

Report: Analysis

Date Upper Lower Mixed Conventional Comments

Jan 21		1			
Feb 2				1	
Feb 3				1	
Feb 5				1	
Feb 9			1		mostly upper
Feb 12				1	
Feb 18			1		mostly upper
Feb 19	1				
Feb 26				1	
Mar 3		1			
Mar 4		1			
Mar 9		1			
Mar 12		1			
Mar 17		1			
Mar 19		1			
Mar 30				1	
Apr 1		1			
Apr 6		1			
Apr 9		1			
Apr 16	1				
Apr 27	1				
Apr 30		1			
May 12		1			
May 22		1			
Jun 2		1			
Totals	3*	14*	2*		6*

File: Letters Mark

Page 1

Report: Analysis

Date Upper Lower Mixed Conventional Comments

Date	Upper	Lower	Mixed	Conventional	Comments
Jan 12				1	
Jan 22				1	
Jan 26	1				
Jan 27		1			
Feb 9		1			
Feb 11		1			
Feb 17	1				
Feb 26	1				
Mar 4			1		
Mar 11	1				
Mar 12	1				
Mar 19			1		
Mar 30			1		
Apr 10			1		
Apr 13	1				
Apr 16			1		
Apr 20	1				
May 4	1				
May 14	1				
May 18	1				
May 26			1		
Jun 2			1		
Jun 3			1		
Jun 4			1		
Jun 5	1				
Totals	11*	12*	2*		

APPENDIX J
SUBJECTS' AGES

Ages of subjects:

	Day	Month	Year
Martha	20	2	81
Christy	1	7	81
Dave	10	10	80
Rachel	18	8	81
Mark	1	12	80
Malcom	4	12	80

Research conducted over a period of 4 months and 23 days.

Beginning Date 12/1/87
Ending Date 5/6/87

	Day	Month	Year	Beg. Age	End Age
Martha	20	2	81	12/1/5	15/3/6
Christy	1	7	81	11/6/5	4/11/5
Dave	10	10	80	2/3/6	25/7/6
Rachel	18	8	81	14/4/5	17/9/5
Mark	1	12	80	11/1/6	4/6/6
Malcom	4	12	80	8/1/6	1/6/6

Chronological Order
Oldest to Youngest

Name	Beg. Age Yr.Mo.Dy.	End. Age Yr.Mo.Dy.
Dave	6 3 2	6 7 25
Mark	6 1 11	6 6 4
Martha	5 10 12	6 3 15
Christy	5 6 11	5 11 4
Rachel	5 4 14	5 9 17

APPENDIX K
GENERIC FORMS FOR PARENT CONCENT

March 16, 1987

Dear Mrs. _____,

Your daughter Martha is one of the subjects of a research study I am completing as a degree requirement at Portland State University. Ms. Bartell suggested Martha and five other students as candidates for this research.

This study consists of my observing kindergarten student's behavior associated with a word processor. As I observe students using this writing tool or interacting with others I record what I see. I do this by writing notes about the activity either with pencil and paper or with a word processor. At the end of my daily observations I often record additional thoughts about what I have seen.

Martha's participation in this study may or may not be of any direct benefit to her. However, her involvement may help to increase knowledge which may benefit other children in the future.

You are welcome to visit the WTR lab and observe my involvement there anytime. If you have questions now or in the future please feel free to contact me at Sabin in person, by note or by phone, 280-6181.

Would you please read, date and sign the attached Informed Consent form. Enclosed is an envelope for returning the consent form to me.

I appreciate your help and cooperation with this research.

Sincerely,

Paul Steger

INFORMED CONSENT

I understand that my daughter, Martha XXXX, is a subject in the research project on the use of word processors by kindergarten children titled: An Analysis of kindergarten children's use of a word processor in their print literacy development, conducted by Paul Steger.

I understand that this study involves the observation of my child and others as they use a word processor when visiting the writing lab at Sabin ECEC and the collecting and analysis of their computer generated compositions.

It has been explained to me that the purpose of this study is to analyze the literacy environment and manner in which kindergarten children use a word processor.

I also understand that my child may not receive any direct benefit from participation in this study, but his/her participation may help to increase knowledge which may benefit other children in the future.

Paul Steger has offered to answer any questions I may have about this study and can reach him at Sabin or by phone, 280-6181. I have been assured that all information will be kept confidential and that the identity of all subjects will remain anonymous.

I have read and understand the foregoing information.

Date _____ Signature _____

If you experience problems that are the result of your child's participation in this study, please contact Robert Tinnin, Office of Graduate Studies and Research, 105 Neuberger Hall, Portland State University, 229-3423.

APPENDIX L
STUDY CALENDAR

Week #	Month	Days	Comments
-	January	5,6,7,8,9	First week after Holidays
1	January	12,13,14,15,16	Begin Data Collection
2	January	X,20,21,22,X	MLK Day, Teacher Plan Day
3	January	26,27,28,29,30	-
4	February	2,3,4,5,6	-
5	February	9,10,11,12,13	-
6	February	X,17,18,19,20	President's Day
7	February	23,24,25,26,27	-
8	March	2,3,4,5,6	-
9	March	9,10,11,12,13	-
10	March	16,17,18,19,20	-
-	March	23,24,25,26,27	Spring Break
11	March/April	30,31,1,2,X	Teacher Plan Day
12	April	6,7,8,9,10	-
13	April	13,14,15,16,17	-
14	April	20,21,22,23,24	-
15	April/May	27,28,29,30,1	-
16	May	4,5,6,7,8	-
17	May	11,12,13,14,X	Writing Festival
18	May	18,19,20,21,22	-
19	May	X,26,27,28,X	Memorial Day, Literacy Inservice
20	June	1,2,3,4,5	Data Collection Completed