COMPUTER READINESS IN GRADE ONE

by

SUSAN E. PHILLIPS
B.H.E., University of British Columbia, 1972

A THESIS SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Faculty of Education

ACCEPTED
FACULTY OF GRADUATE STUDIES
[redacted]
DEAN
DATE March 12, 1987

We accept this thesis as conforming
to the required standard

[redacted]

Dr. Walter Muir

[redacted]

Dr. Betty Collis

[redacted]

Dr. Lloyd Ollila

[redacted]

Dr. Bram Goldwater

University of Victoria

December, 1986

Supervisor: Dr. Walter Muir

ABSTRACT

The purpose of the study was to examine the effects that the implementation of a computer-based learning system into a first grade classroom had on the computer knowledge, computer-using skills and keyboard skills of the students.

Two groups of first grade students provided the data for the study. Both groups were interviewed and pretested. Approximately three months later, the two groups were posttested. During the intervening three months, one of the groups, the Experimental Group, had used a computer-based learning system as part of the reading and writing curriculum. The second group, the Control Group, did not use computers in the classroom during the three-month period.

The results indicated that the average child tested had an initial knowledge of what computers looked like and what they were used for. However, the average child could not identify computer components, boot a computer correctly, nor input accurately on a keyboard.

After the three month period of computer use, the posttest results from the Experimental Group indicated significant improvements in the areas tested. The posttest mean scores from the Experimental Group in Computer Vocabulary, Computer-Using Skills and Keyboard Skills were all significantly greater than the corresponding mean pretest scores.

Comparisons of the pre- and posttest mean scores from the Control Group also indicated significant improvement over the three months in the Computer Vocabulary, Computer-Using Skills and Keyboard Skills tests. However, *t*-tests were carried out on the posttest mean scores from the Experimental and Control Groups and showed significant differences. The Experimental Group mean scores had improved significantly when compared to the mean scores from the Control Group in all the three posttests.

The study supported the conclusions that first grade students can learn to use computers successfully as educational tools, and that they do have the psychomotor abilities necessary to acquire keyboard skills.

Examiners:

[redacted]

Dr. Walter Muir

[redacted]

Dr. Betty Collis

[redacted]

Dr. Lloyd Ollila

[redacted]

Dr. Bram Goldwater

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Acknowledgements

I would like to express my sincere thanks to the individuals and groups who have enabled me to complete this degree:

to Dr. Walter Muir, my advisor, who provided guidance and support throughout my degree, as well as critical, helpful editing during the process of writing and revising the thesis;

to Dr. Betty Collis, of my supervisory committee, who provided initial direction for the study, as well as continuous encouragement;

to Dr. Lloyd Ollila, also on my committee, for his time and valuable comments;

to Dr. Bram Goldwater for consenting to act as an external examiner;

to the teachers and students of Ruth King Elementary School and Saanichton Elementary School for permitting me to gather data in their classrooms;

to IBM Canada for its contribution of computer equipment and the Writing to Read software;

to my parents and my son who were patient, understanding and supportive throughout the whole process.

CHAPTER 1

Introduction

During the past decade some say that a revolution has been taking place in the schools of North America. Microcomputers have invaded elementary, as well as secondary, classrooms at a rate that has caught the educational community by surprise. "Computer literacy" has become a topic of great interest and concern to parents, as well as to teachers and school administrators. However, the implementation of computer technology has not been without problems. Maynard (1986) has stated that "The race towards computer literacy leaves provincial officials scrambling to formulate policies, boards of education scrounging for funds to buy equipment, and many computer-shy teachers lagging behind their students" (p. 13).

These problems exist when computer technology is implemented at both elementary and at secondary schools. However, there are other problems that are particularly relevant when computers are introduced into primary schools. For example, a problem frequently encountered is the students' lack of knowledge about the technology associated with computers. Children in primary grades may not have had the exposure to, nor the experience with, equipment and machinery that older children may have had. Because of this, additional instruction in basic computer usage and knowledge may be required and this would necessitate a time committment from the teacher which he or she may not have available.

Other problems stem from the facts that young children have short attention spans and they do not usually have the ability to read (Hungate, 1982). These considerations present further obstacles to the educator attempting to initiate computer-related activities in the primary classroom. Software packages or programming languages that require few reading skills, but still keep the children's attention must be acquired or written before the computer can be used as a practical educational tool.

Similarly, primary children do not usually have keyboard skills, and some may not have the psychomotor abilities necessary to acquire them. Again, this necessitates specialized software that does not require the ability to input on a keyboard accurately in order to be used successfully.

Despite these problems associated with implementing computer technology into the educational environment, producing "computer literate" students is still an important goal to educators and parents (Howlett, 1986; Watt, 1983). Schools have been inundated with computers, and some teachers are using them in whatever ways they possibly can. As a result, pupils in the primary grades may be introduced to computers before they are capable of understanding and using computers effectively.

Purpose of the Study

The purpose of this study was to examine the effects that the introduction of computers into a first grade classroom have on the computer knowledge and computer-using skills of the pupils. The information produced should help educators make more informed decisions about student capabilities when implementing computer activities into the primary grades.

With computer knowledge becoming more valuable to students today (Ungerleider, 1983), it is important to discover at what age it is appropriate to introduce computers into a child's learning environment. Some educators have suggested that the earlier children learn to use computers, the better off they will be. Palamara has stated in an interview with Long (1982) that he found young children "to be inquisitive and open to new concepts. During the early years, they can quickly develop a perception and appreciation of computers" (p. 312). This present study examined students using computers in the first grade and attempted to reach some conclusions about the practicality of introducing computers at this grade level.

An important part of learning to use computers efficiently is the ability to develop correct keyboarding techniques (Davis & Little, 1984). The success of the methods of computer instruction and of the use of computer-aided learning (CAL) packages frequently utilized in the primary classroom is partially dependent upon the pupils' abilities to learn how to type on keyboards. However, there have been few research studies carried out on the fine psychomotor skills of young children (Goodwin & Driscoll, 1980) and there is no agreement as to whether these children have the ability to learn how to type accurately on a keyboard. The present study assessed the keyboarding skills of the children tested and suggested insights into the ability of the children to acquire keyboard skills, as well as information about the association of the children's gender and their ability to acquire these skills, and about the relative difficulty of inputting the various keyboard letters.

CHAPTER 2

Review of Literature

Research into Computer Education in the Primary Grades

The need to know how to use computers effectively as educational tools is necessary if computers are to be in our primary schools. However, research on the use on computers in the primary grades is very limited. Maddux (1984) has stated that "the most critical need in educational microcomputing is the need for good research. Children are receiving very limited amounts of instructional computing time, and research is needed in order to make intelligent decisions about how that time should be spent" (p. 40).

Social Involvements and Achievement Levels

There has been some research carried out on the impact on children's social involvements and achievement levels when computers are introduced into the learning environment. Taylor (1983) did a study on a day care facility which extended its curriculum to include microcomputers. She found that microcomputers can add a positive dimension to a child's learning environment by their being "introduced into that environment as a plaything, and as a means of adding an extra dimension to a child's learning experience" (p. 8).

Nieboer (1983) also studied the addition of a microcomputer centre into a day care facility and concluded that "the inclusion of a microcomputer center in the preschool setting appears to be a positive and wholely justifiable act" (p. 25) and that it "allowed opportunities for fine motor development, creative involvement, verbal expansion, problem solving, widened experience, success and pride in achievement" (p. 25).

In a third study, Shrock (1985) investigated the effects on children's behaviour and interactions after introducing a microcomputer into a combined second and third grade classroom. She found that some of the children "had an avid interest in the machine, while others gave it only superficial and fleeting attention" (p. 6). She also found that the older children appeared to have fewer interactions surrounding the computer, when compared to the younger children, as the length of time that the computer was present in the classroom increased. She speculated that this may, at least partially, have been because the younger children still needed assistance in operating the machine.

These three studies were all carried out using a naturalistic or case study paradigm. The researchers recorded observations over a period of time and drew conclusions from these. In only one of these studies (Nieboer's) were there any numerical data produced, which were used, to a limited extent, as justification for the conclusions that were drawn.

In order to help children feel at ease when using computers for school-work, Zigich (1982) developed and implemented a program to acquaint four first grade children with microcomputers. He pretested the children for prior knowledge, instructed them in terminology, computer operations, programming and game-playing, and then posttested them after nine weeks of instruction.

He stated that as a result of his study and research into literature, he was confident that, "time, patience and accessibility are the only necessary prerequisites to teaching first graders about computer use" (p. 9).

Further evidence to support this conclusion was provided by Piestrup (1981). She studied 55 preschool children who were taught reading readiness concepts using a microcomputer. She stated that "clearly preschool children were not intimidated by a microcomputer and enjoyed using it as part of their play" (p. 10).

Gender and Computer Usage

The effects of young children's gender on their choice of the computer as an activity in the classroom is a second major area of study in educational computing. The computer field is perceived to be a predominately male domain (Wilder, Mackie, & Cooper, 1985), and there have been a number of studies designed to provide evidence about whether this sex-stereotyping is present when young children are exposed to computers. For example, Beeson and Williams (1985) studied 32 children between the ages of four and six enrolled in a preschool program into which a computer was introduced. The children were free to choose five child-selected activities during a day and data were collected as to the number of times computers were chosen as an activity. As a result of the analysis of the data collected, Beeson and Williams concluded that "there is no difference between males and females in the use of the computer" (p. 341).

A second study was carried out by Johnson (1985) on 20 preschool children. The purpose of this study was to determine characteristics of young children who used microcomputers during their free choice time in a preschool program. After collecting data over a three-month period, Johnson concluded that the computers users were just as likely to be males as females.

Woodill, Anderson, and Bernhard (1985) carried out a third study on 36 preschool children between the ages of two and five. The researchers recorded the number of times the children requested turns at the computer over an approximate two month period. The results from their study "showed no major gender differences for any age group in the number of times the children asked to use the computer" (p. 324).

Sprigle and Schaefer (1984), in a fourth study, observed three- and four-year olds at four different computer tasks. They were interested in the difference in computer programming abilities between the two age groups and between males and females. They found that "four-year-olds not only learned more easily the tasks presented to them but learned them more thoroughly than their younger playmates" and that "the child's gender had no significant effect on any of the tasks" (p. 249).

These four studies all provide evidence that the gender of preschool children is not associated with their desire to use computers. This attitude changes, though, as children grow older. The number of males in coeducational computer classes in middle and high schools, and in colleges and universities is consistently higher than the number of females (Wilder et al., 1985).

Further research is needed to understand where and how these attitudes are changed, and how educators can prevent sex-stereotyping in computer education from occurring.

Computer Applications in Primary Education

Computers present new opportunities for educators to consider in their search for effective instructional methodologies. These opportunities are gradually being explored as computers are used more in educational environments. For example, in Oakville, Ontario, Mander (1982) studied a system using microcomputers that was developed to teach preschool children to read and write. The children begin the course by comparing objects and pressing "S" if they are the same and "D" if they are different. The content of the course then increases over the weeks until it culmulates with the children having created an eight-line "story". Mander found the program to be a successful method of teaching young children reading and writing skills. This conclusion was based on reactions from teachers who eventually taught the students, and from the involved students' parents.

A second application of computers was studied at the Developmental Research School at Florida State University. Kindergarten children were taught to use a word processing program to create and explore text. Piazza and Riggs (1984) observed these children and drew a number of conclusions about children learning to write on a computer as compared to the traditional method of paper and pencil. Piazza and Riggs stated that:

> Writing with a word processor is a pleasurable experience for children because it helps them to write easier and longer and because it results in a legible product. Simple word processing functions permit children to concentrate on meaning rather than on handwriting, often an arduous physical task for them. (p. 66)

The conclusions from this study indicated that the quality of a child's writing may improve once the task of producing the material in long-hand is removed. Furthermore, when children have the use of a computer to do word processing, their attitudes toward writing may improve significantly. These are important findings for any teacher instructing young children in writing skills.

A third application of using computers with young children was examined by Naymark and Plaisant (1986). They studied approximately 150 children, ages four to six, learning the written word through computer programs. The programs were tested and evaluated over a period of one year, and the observations made showed that "as an interactive pedagogical tool the computer can be effectively exploited by young children" (p. 170). The conclusions drawn indicated that although further study is planned, and more programs are to be developed, children can, at the primary level, "learn to learn" from computers.

In the above three studies, the computers were used in the classrooms as educational tools to run software packages designed to achieve specific learning objectives. However, young children can also learn how to program computers. Papert (1982), along with others from the Massechusetts Institute of Technology, have created a computer language, Logo, designed to allow children to control computers by programming them. Papert has stated that "computers will allow children to engage in a more Piagetian style of learning" (p. 86) than the traditional "teacher-driven learning" will permit by teaching them the techniques of problem-solving. This can be accomplished by the children testing hypotheses and exploring new concepts through moving a turtle around the screen by issuing commands on the computer.

Similar to the programming of conventional computers, is the programming and controlling of robots containing microprocessors. Keller and Shanahan (1983) observed an experimental group of kindergarten children learning to move a robot-like tank around a classroom and eventually through a complex maze. They stated that the children learned how to solve the problem of moving the tank accurately, by learning to estimate directions and distances as they moved it around. Listening and mathematics subtests scores from the experimental and from control groups suggest that the project using the robot contributed to higher scores in both areas.

Teachers can use computers in exciting and innovative ways to stimulate students and to improve the learning process. The search for new and different methods to make use of computers in classrooms has only just started; teachers are challenged to experiment with the new technology to discover ways to increase the amount of learning accomplished in their classrooms.

Computer Aided Instruction

Computer Aided Instruction (CAI) has been defined by Gledhill (1985) as "the use of the computer to provide instruction through tutorials, simulations, games and drill and practice exercises" (p. 89). One of the main reasons computers are introduced into the primary grades is to use them for CAI. As Junyk (1986) has stated, with the use of CAI packages, young children can experience several different kinds of learning, such as fine motor skill, eye-hand coordination, memory-building, sequential thinking, and mathematics and language concepts.

Writing to Read. There are a number of CAI software packages targeted for use in the primary grades today. These packages have been developed to teach a variety of learning objectives, one of the most common being to instruct reading skills. An example of a CAI system designed to do this is Writing to Read (WTR) which is presently being tested in select classrooms across Canada. It has been developed to teach children to write without concerning themselves with the inconsistencies of the English spelling system.

In the early 1970's, Dr. John Henry Martin "concluded that children can learn to write words the way they sound and they can do this before they learn to read" (p. 21). His theory was that children can write what is heard and thought, without learning how to correctly spell each word. Instead they would use a phonemic alphabet to write down what they wished to communicate. In 1977, Martin, with the loan of 16 typewriters from IBM, began testing his programme, which he termed Writing to Read, in a research lab. Since then he has continued to expand the original programme. He has developed the system into one that can be used in secondary schools and he has enhanced it to include the use of microcomputers.

In 1981, under an arrangment with IBM, Martin added a CAL component to WTR. The computer-based WTR system uses five work-stations, one of which is a microcomputer system. The child at the computer work-station hears words through earphones and sees pictures of them displayed on the monitor. He or she is then asked to respond by typing the word into the computer from the keyboard. The child's response is evaluated and feedback is given both orally and visually.

The Educational Testing Service (ETS) performed an extensive evaluation on the WTR system. The results were published in July 1984. The major conclusion was that "Writing to Read is an effective educational program" (p. 1). This conclusion is relevant as it shows that a system that is partially computer-based can be successful as a teaching instrument in the primary grades. The results from the evaluation showed that not only were the students who used the WTR system as able in spelling as other children, but that they also had significantly better comparative results in their reading and writing performances.

A second conclusion, that "students could handle the technology required: The IBM Personal Computer" (p. 1), offered evidence that primary-level children have the ability to use computer technology, and that by supplying this grade level with computers, money is not being wasted.

Another concern regarding the implementation of computer-based courses into schools is the possible negative reactions to the computers from parents and teachers. The ETS evaluation found that "Teachers respond positively to Writing to Read" (p. 3) and "Parents respond positively to Writing to Read" (p. 4). These conclusions support the hypothesis that if computers are introduced into schools, with good learning software and sufficient training and information for the parents and teachers involved, then they will be accepted, and endorsed, by those affected.

Measurement Methodologies for Primary Grades

There are a variety of methods that can be used to assess knowledge and abilities in the primary grades. These methods all have advantages and limitations depending upon the nature of the quality being measured.

Interviews

Interviews are an important methodology for collecting information. As TenBrink (1974) has pointed out "Interviewing is a valuable information-gathering technique because it allows you to get information which would be difficult to obtain in any other way" (p. 170). This is particularly true when dealing with children at the primary grade level.

When planning an interview, TenBrink wrote that the interview questions should be "short and easy to understand" (p. 305) as they are to be presented orally. The respondent is not able to go back and reread a question, but must remember the question as he or she is searching for a reply to it. He also stated that during the interviews, responses must be carefully recorded as the questions are answered, in order to ensure as much accuracy as possible.

Objective Measurements

Objective tests have many characteristics that make them easy to use, but also permit them to supply valuable data. Some of the characteristics, as Phillips (1968) described, of objective tests that are important in a testing situation, are that they can "tap high levels of reasoning such as required in inference, organization of ideas, comparison and contrast", that they can measure "knowledge of facts efficiently", that they "can be scored quickly", and that the "scoring is very accurate and consistent" (p. 63).

Observations

Goodwin and Driscoll (1980) state there are three reasons that observational measurement is important in early childhood education. First, young children may not have the necessary repertoire to respond in an interview or to a verbal test, and therefore may appear to know far less than they actually do. Second, young children often do not take the testing procedure seriously, and fail to cooperate during the proceedings. Third, children of this age have not learned to hide or act out of character when they know they are being observed.

Walker (1973) decribed problems associated with testing young children using non-observational techniques. She noted that their attention spans are shorter, they lack the necessary skills often required in testing situations such as reading and writing, and they desire to please adults and therefore tend to respond as they feel the test administrator wants. She concluded by stating "because of these special problems encountered in testing young children, the most reliable and valid measures available at the present time are the observational, nonverbal techniques" (p. 38).

Observational techniques, however, can only be used to measure activities that can be observed. It is difficult to assess other capabilities and expertise, such as prior knowledge, using these methodologies.

Fine Motor Skill Measurement

There is little information about fine psychomotor skills and young children available in the literature. Furthermore, there does not seem to be the research interest in psychomotor skills, such as keyboarding, as there is in other areas. Goodwin and Driscoll (1980) stated that, of over 3500 research proposals funded in 1975 by American federal sources, "the proportion of psychomotor measures used was somewhere above 3 percent but less than 6 percent" (p. 302).

The psychomotor skill involved in keyboarding is, however, of major concern to educators using microcomputers in their classrooms. Davis and Little (1984) have stated that "computers are now available for use by many elementary, junior high school, and high school students in schools and homes; therefore correct keyboarding techniques should be acquired to enhance computer efficiency" (p. 104). However, how to best accomplish this acquisition of keyboard skills is not clear.

If keyboarding is an important aspect of learning to use a computer effectively, and, therefore becomes an educational goal in the primary grades, it should be taught as soon as children have the ability to learn the skills. The age at which correct keyboarding techniques can be successfully taught, however, is a question which has yet to be answered. Brady (1984) has pointed out that "many piano teachers prefer to begin training children at age five; how is typing different? And if we do find that kids can learn to type in the early grades, what impact will that have on their writing?" (p. 69). This implies that if children can be taught how to play the piano at the age of five, then they should be able to learn typing skills at the same age. It follows that if they can learn to type, then they can use a computer more effectively, which should in turn produce positive impacts on their writing skills by permitting them to use word processing packages.

Summary of the Literature Reviewed

The literature review began by examining some of the current research on computers in primary schools. From the studies reviewed, two major conclusions could be drawn: (1) there has been evidence produced that indicates that there are positive consequences resulting from the introduction of computers into primary grade classrooms, and (2) preschool students who have been studied do not perceive the use of computers to be a male-dominated activity.

The review then discussed a number of different applications that computers are used for in primary schools. Educators are just beginning to experience the wide variety of functions that computers can accomplish in a learning environment. In the primary classroom, these functions most frequently are to run CAI packages and to use a computer's text processing capabilities, although with the development of Logo and other simple programming languages, learning to program is becoming more common.

The Writing to Read (WTR) system was discussed as an example of a proven CAI system developed to utilize some of the powerful capabilities of computers to teach young children how to write and read.

Based on the literature presented in the review, it was clear that the best method of assessing the knowledge and skills of students in the primary grades was by utilizing a number of different forms of measurement. These forms were (1) interviews, (2) objective measurements, (3) observational measurements, and (4) fine motor skills measurement. Each of these measurement techniques have characteristics which cause it to be the preferred method for assessing particular abilities under specific circumstances.

CHAPTER 3

Rationale and Hypotheses

Rationale

Research into the use of computers in the classroom has been identified as an important educational computing need (Maddux, 1984). The purpose of this study was to provide information based on the data collected from the examination of the introduction of computers into the first grade. This information, and the results based upon it, when carefully studied, should help educators to make informed decisions regarding the use of computers in the classroom.

Information on the amount of computer knowledge that children have already acquired before starting school was included as part of this study. It is important for teachers to be aware of this level as it would help them to eliminate redundancy in subsequent computer literacy training and give them a starting point from which to develop the curriculum content for introductory computer courses. This information should also provide an assessment of the computer competencies of the primary-level child, which is important when using computer-based instructional methods of teaching.

In order to improve teaching effectiveness, it is necessary to discover competent and efficient methods of teaching young children about computers. This study examined one method of teaching computer awareness and skills, which was to have students use microcomputers as tools for learning how to read and write. The information from this study should show if this method of teaching the computer skills measured was successful.

Keyboarding skills are an important part of computer usage, both in programming the computer and in using CAI software (Davis & Little, 1985). The psychomotor abilities of children at the first grade level to improve their keyboard skills has not been been thoroughly investigated. This study will provide information about keyboard skill acquisition and improvement over the period of time in which the children used computers in the classroom.

Measuring instruments to test microcomputer skills and knowledge at the primary grade level were not available, and, therefore, had to be developed. An important contribution from this study will be these instruments and the data collected from using them. They should provide relevant information for others planning research on computer knowledge, using skills and keyboard skills in the primary grades.

To provide data for this study, two groups of students were interviewed and tested. The first group, the Experimental Group, were interviewed and pretested before a computer-based system was implemented as part of the reading and writing curriculum. The posttests were administered approximately three months later. The second group, the Control Group, were interviewed and pretested, and then posttested approximately three months later. They did not have computers in their classroom up to the time of the posttesting.

Research Questions and Hypotheses

Research Questions

There were four questions which this study attempted to address. These were:

1) What is the functional level of computer knowledge that children have acquired before entering the public school system, from their own experiences, the media, and other influences?

2) Does the daily use of computers in the classroom by first grade children result in a significant improvement in computer vocabulary and computer-using skills when compared with children who do not use computers?

3) Do children at the first grade level have the fine psychomotor development necessary to acquire keyboarding skills?

4) Is the gender of the child related to his or her ability to acquire keyboarding skills?

Hypotheses

In order to provide information on the second, third and fourth research questions, three sets of null hypotheses were tested. The first set was tested to determine whether there was a significant change in computer functional knowledge in the Experimental Group after three months of daily computer usage.

Ho:1 There will be no significant mean difference on the Computer Vocabulary posttest between the Experimental and Control Groups.

Ho:2 There will be no significant mean difference on the Computer-Using Skills posttest between the Experimental and Control Groups.

Ho:3 There will be no significant mean difference on pretest and posttest Computer Vocabulary scores within the Experimental Group.

Ho:4 There will be no significant mean difference on pretest and posttest Computer-Using Skills scores within the Experimental Group.

A second set of hypotheses was tested to determine if there was a significant change in the keyboard skill level in the Experimental Group after three months of daily computer usage.

Ho:5 There will be no significant mean difference on the Keyboard Skill posttest between the Experimental and Control Groups.

Ho:6 There will be no significant mean difference on pretest and posttest Keyboard Skill scores within the Experimental Group.

A final hypothesis was tested to determine if gender in the Experimental Group is associated with the ability to acquire keyboard skills after three months of daily computer usage.

Ho:7 There will be no significant mean difference on posttest Keyboard Skill scores between males and females in the Experimental Group.

CHAPTER 4

Method

Subjects

The subjects for the present study were all in the first grade. A total of 54 children were pretested; 27 in each group. However, two children in the Experimental Group and one in the Control Group were no longer attending the schools when the posttests were administered, and therefore the data collected from them were dropped from the analysis.

The Experimental Group was one of the pilot classes for the Writing To Read (WTR) program. The Control Group was a first grade class in another school that had not had any exposure to microcomputers in their classroom to the time of administering the posttests.

The mean age of the Experimental Group at the time of the pretesting was 6.5 years. There were 13 males (mean age 6.6 years) in this group, and 12 females (mean age 6.4 years). In the Control Group, the mean age at the time of pretesting was the same as for the experimental group, 6.5 years. There were 13 students of each sex in this class (male mean age 6.6 years, female mean age 6.4 years).

None of the children in either the Experimental Group or the Control Group were physically or mentally handicapped. There was one East Indian student in the Experimental Group and three Native Indian students in the

Control Group.

The schools from which the Experimental and Control Groups were drawn are both located in the southern part of Vancouver Island and serve communities of similar social economic status (SES), lower-middle to middle class. The communities, Saanichton and Langford, are both approximately 20 kilometers from downtown Victoria.

The students participating in the WTR program had been assigned to one of two first grade classrooms in the school. The assignment process involved the students being assessed by their kindergarten teachers and ranked according to their academic abilities. They were then assigned to a class in an alternate manner, with the even-numbered students being assigned to one class and the odd-numbered to the other. Thus, the Experimental Group was composed of children who were assigned to classrooms in a manner designed to yield classes that were assumed to be of equal mean ability. The Control Group was the only first grade class in the other school.

Measuring Instruments

Interviews

An interview (see Appendix A) was conducted personally with each child. He or she was asked a series of questions which helped to establish his or her knowledge of computers. The interview consisted of questions that were designed to be answered with either a yes/no response or with a very short reply. The researcher wrote down the children's responses as they were interviewed. No coaching or verbal reinforcement was given.

Objective Tests

There were four objective tests (see Appendix B) administered orally to measure computer identification, recognition, usage and functions. Three of these tests used 22 five-inch by eight-inch cards (see Appendix E) onto which pictures of various machines had been laminated. These pictures included well-known appliances (eg. a coffee maker) and unfamiliar machines (eg. a router), as well as pictures of microcomputers and computer peripherals (eg. a joystick). The fourth test was a series of questions that the subjects were asked about the functions of computers.

Computer Identification. This test involved having the student identify each of the 22 pictures, and had two major purposes. The first was to acquaint the student with the pictures and the second was to discover whether the child had a deficiency that should cause disqualification from the remaining measuring procedures. This problem did not occur in any of the 54 students initially tested. No score was given for this test.

Computer Recognition. The second test, computer recognition, used the same cards. The child was asked to find pictures of 15 various machines, for example, a typewriter. A picture of the requested machine was not necessarily present. There was also a possibility of more than one picture of the machine being present. The child was told this before the test began. The purpose of this test was to assess the degree of recognition of computers and computer peripherals; that is, to discover if the child could correctly identify all computers and peripherals, and not include machines which did not fit into these categories. A score out of eight was given as there were eight possible computer or peripheral pictures to be identified.

Computer Usage. The third test, computer usage, again used the same cards. The child was asked to find pictures of machines that could perform various functions. This test was designed to determine if the child could correctly identify in which situations a computer would or would not be used. The Computer Usage test had a total possible score of nine marks.

In the three tests described above, both the cards with pictures laminated onto them, and the questions asked, were presented to the students in a constant predetermined order.

Computer Functions. The fourth test consisted of a list of tasks. The child was asked whether a computer could be used to perform these tasks or functions. Yes/no answers were all that were required. The purpose of this test was to determine if the child could correctly identify functions that computers perform. There were 10 functions given and therefore 10 possible marks.

Observational Measurements

There were two different observational measurement tests (see Appendix C) administered to each of the children. These were carried out with the child seated in front of a microcomputer system which consisted of a keyboard, a monitor, and a central processing unit containing a disk drive.

Computer Vocabulary. The first of these tests was developed to measure the child's familiarity with computer vocabulary. The child was shown a diskette and the microcomputer system. The child was then asked to point to specific parts of the system and to important keys. The ones that were properly identified were recorded. This test required the identification of nine parts of the computer system and therefore had a total possible score of nine marks.

Computer-Using Skills. The second observational measurement test was developed to measure computer-using skills. The child was given a diskette and asked to boot the machine. The number of correct steps in the necessary order that the child followed was recorded. This procedure required seven steps (see Appendix C) and therefore this test was marked out of a possible seven marks.

Keyboard Skills

The fourth type of measuring instrument developed was based on a computer program (see Appendix D), which displayed 20 different letters in a consistent, predetermined order in the center of a computer's monitor. The size of the letters were approximately one centimetre high, twice the usual size of a character displayed on an 80 column monitor. The child was given 4.28 seconds to type a response, then a new character was displayed. The length of time that was allowed to elapse was determined as a result of the pilot study (see Appendix F). The time lapse allowed the children time to respond, but was not so long as to allow all responses to be correct each time. The program recorded the child's responses, the length of time each response took, the number of correct responses and the average time that a correct response took for that session. There was no reinforcement or feedback given. Twenty different letters were displayed, one at a time, on the monitor during this program and therefore there was a possibility of 20 correct responses.

Procedure

The children in the Experimental and Control Groups were individually tested by the researcher. A microcomputer system was present but out of sight until it was needed for the observational measurement and keyboard skill tests.

The pretesting of the Experimental Group was carried out the week beginning November 19th, 1984. The pretesting of the Control Group was carried out on December 10th and 11th, 1984.

Each child was interviewed regarding his or her previous computer experience. The series of four objective tests were then administered and the responses were recorded. Following these, the student was introduced to the microcomputer system and the observational tests to measure computer vocabulary and computer-using skills were carried out. Finally, the child was asked to respond on the keyboard to the computer program developed to record information regarding the child's keyboarding skills.

The posttests were administered to the Experimental Group on March 28th, 1985, and to the Control Group on March 4th, 1985. There were three posttests administered to the children. The first two were the observational tests administered in the pretest situation to measure computer vocabulary and computer-using skills. The third posttest was the keyboard skill test developed to measure the accuracy of the students' input on a keyboard.

CHAPTER 5

Results and Discussion

Research Question One

What is the functional level of computer knowledge that children have acquired before entering the public school system, from their own experiences, the media, and other influences?

To respond to this question, this study produced a description of the functional level of computer knowledge and skills that an average child in the sample selected for the study had acquired before starting the first grade. This description was based on the information collected during the interviews, as well as upon the data received from the six tests (Computer Recognition, Usage, Functions, Using Skills, Vocabulary and Keyboard Skills) administered in the pretest situation.

The data used were collected from 51 students, although 54 were originally tested. Three students were no longer attending the schools when the posttesting was carried out.

The interview results indicated that seven students (13.73%) out of the 51 tested had computers in their homes, two in the Experimental Group and five in the Control Group. The number of students who had computer experience in kindergarten was 15 (29.41%) out of the total number interviewed. The Experimental Group had a higher average, with 11 out of 25 (44%) having had kindergarten experience as compared to four out of 26 (15.38%) for the Control Group.

There were 26 students, or 51% of the total number tested, who said they had previous computer experience. This average was, again, higher for the Experimental Group at 60% (15 out of 25) as compared to 42.3% (11 out of 26) for the Control Group. "Previous computer experience" meant that a child had actually used a computer at least once in some capacity.

In an attempt to determine how the computers had been used, the children that had responded positively were asked in what capacity they had used the computers. In the Experimental Group, ten of the students had used computers to play games, with the other five having used them to type letters and words. In the Control Group, seven students had used computers to play games and the remaining four had used them for typing.

Out of the 51 students tested, 12 students (23.5%) said they had friends with computers in their homes. Five of these students were from the Experimental Group, with the remaining seven coming from the Control Group.

There were 43.1% (22 out of 51) of the students who responded positively to the question about their parents using computers at work. In the Experimental Group, eight students (32%) said their parents used computers at work; in the Control Group 14 (53.8%) said their parents did.

Thirteen or 25.5% of the students tested, indicated they had siblings who use computers at school. In the Experimental Group, five students indicated this was the case, whereas in the Control Group, eight students said that this was true.

There were 30 students, or 58.8% of the 51 tested, who said they had a typewriter in their classroom at school, and had used it at least once. The averages were very close for the two groups, with 12 out of 25 (48%) from the Experimental Group, as compared with 50% or 13 out of 26 for the Control Group.

The interviews, therefore, established that the majority of children did not have microcomputers in their homes, nor had they had computer experience in kindergarten. However, half the students (51%) had used a computer in some capacity at least once and this was usually for the purpose of playing games.

The majority of the children tested did not have friends with computers at home, their parents did not use computers at work and their siblings did not use computers at school. However, almost 60% of the students said there was a typewriter in their classroom, and that they had used it at some time.

After the interviews were concluded, the objective, observational and keyboard skill tests were administered. The means recorded from the Experimental and Control Groups for these tests are printed in Table 1. The overall means for the two groups are displayed in Table 2.

TABLE 1

Means, Standard Deviations, and t-tests for Pretest Scores

Variable	Experimental *M*	*SD*	Control *M*	*SD*	*df*	*t*	*p*
	n=25		*n*=26				
Computer Recognition	3.20	1.92	3.69	1.57	49	1.01	n.s.
Computer Usage	3.16	1.75	3.27	2.20	49	.20	n.s.
Computer Functions	9.12	1.51	9.00	.80	49	.36	n.s.
Computer Vocabulary	1.96	1.49	1.35	1.47	49	1.48	n.s.
Computer-Using Skill	2.44	1.39	1.96	1.69	49	1.10	n.s.
Keyboard Skills	6.80	4.29	7.39	3.76	49	.52	n.s.

TABLE 2

Overall Means and Mean Percent Correct for Pretest Scores

Variables	Total Score Possible	Mean	Mean Percent Correct
Computer Recognition	8	3.45	43.13
Computer Usage	9	3.22	35.72
Computer Functions	10	9.06	90.60
Computer Vocabulary	9	1.65	18.37
Computer-Using Skill	7	2.20	31.44
Keyboard Skills	20	7.09	35.46

n = 51

The results from the objective tests indicated that the children tested, on average, correctly identified pictures of computers or computer peripherals 43.13% of the time (Computer Recognition). They also correctly identified pictures of computers or peripherals that could be used to perform certain tasks 35.72% of the time (Computer Usage). In over 90% of the cases tested, the children were able to state correctly if computers could be used to perform certain functions (Computer Functions).

The children successfully identified components of the computer system 18.37% of the time (Computer Vocabulary). When they were observed as they attempted to boot the computer, they were able to follow the correct steps in the required order on an average of 31.44% of the time (Computer-Using Skills). None of the children managed the whole procedure successfully.

During the Keyboard Skill test, on average, the children correctly input the letter displayed on the monitor 35.46% of the time.

The results from these tests indicated that the children knew more about computers (how computers looked, what they were used for) than they did about the specific components of a computer system or about how to correctly use one.

In order to continue with the analyses and respond to the next two research questions, it was necessary to establish that there were no initial significant differences between the Experimental Group and the Control Group with respect to computer knowledge and abilities. *T*-tests for each of the six tests initially administered (Computer Recognition, Computer Usage, Computer

Functions, Computer Vocabulary, Computer-Using Skills, and Keyboard Skills) were carried out. The hypothesis tested for each of these tests was that there would be no significant difference between the pretest means from the two groups. The null hypotheses could not be rejected for any of the six tests. Table 1 shows the results of these analyses, which indicated that with respect to computer recognition, usage, functions, using skills and keyboard skills, there were no significant initial differences between the two groups.

Research Question Two

Does the daily use of computers in the classroom by first grade children result in a significant improvement in computer vocabulary and computer-using skills when compared with children who do not use computers?

Hypothesis 1

Ho:1 There will be no significant mean difference on the Computer Vocabulary posttest between the Experimental and Control Groups.

In order to test this hypothesis, initial equivalency between the Experimental and Control Groups for the Computer Vocabulary pretest was established by a *t*-test. The result is in Table 1, and indicates that there was no initial significant mean difference between the two groups, $t(49) = 1.48$, p = n.s.

A *t*-test was then carried out on the Computer Vocabulary posttest mean scores. The result from the *t*-test is in Table 3. It indicated rejection of the null hypothesis for the dependent variable, Computer Vocabulary, as the difference was significant, $t(49) = 6.69$, $p < .001$. The Experimental Group showed a significant improvement when compared to the Control Group in its ability to indicate the specific components of a computer system.

Hypothesis 2

Ho:2 There will be no significant mean difference on the Computer-Using Skills posttest between the Experimental and Control groups.

To test this hypothesis, it was necessary to establish initial equivalency between the pretest Computer-Using Skills mean scores from the Experimental and Control Groups. A *t*-test was carried out, and the result, in Table 1, indicate there was no significant mean difference on the pretest between the two groups, $t(49) = 1.1$, p = n.s.

A *t*-test was then carried out on the Computer-Using Skills posttest mean scores from the Experimental and Control Groups. The result of this *t*-test is in Table 3 and indicated that the null hypothesis for treatment effects between the Experimental and Control groups was rejected on Computer-Using Skills, $t(49) = 5.8$, $p < .001$. Children in the Experimental Group, when compared with children in the Control Group, showed significant improvement as they were observed when attempting to boot the computer system.

TABLE 3

Means, Standard Deviations, and t-tests for Posttest Scores

Variable	Experimental *M*	Experimental *SD*	Control *M*	Control *SD*	*df*	*t*	*p*
	n=25		*n*=26				
Computer Vocabulary	5.12	1.24	2.70	1.35	49	6.69	<.001
Computer-Using Skill	4.88	1.13	2.73	1.49	49	5.80	<.001
Keyboard Skills	15.80	3.27	11.15	3.95	49	4.57	<.001

Hypothesis 3

Ho:3 There will be no significant mean difference on pretest and posttest Computer Vocabulary scores within the Experimental Group.

A correlated *t*-test was carried out to test this hypothesis. As the results in Table 4 indicate, the hypothesis was rejected for the Computer Vocabulary test, $t(48) = 8.48$, $p < .001$. The differences between the pretest and posttest results were significant, indicating that the students in the Experimental Group had improved significantly from the time of the pretesting to the time of the posttesting in their ability to identify computer components.

Hypothesis 4

Ho:4 There will be no significant mean difference on pretest and posttest Computer-Using Skills scores within the Experimental Group.

A second correlated *t*-test was performed to test this hypothesis. As the results in Table 4 indicate, the null hypothesis was rejected for the variable Computer-Using Skills, $t(48) = 8.61$, $p < .001$. The difference between the mean scores from the pretest and posttest indicated that the children in the Experimental Group showed a significant improvement in their ability to boot up a computer system.

TABLE 4

Correlated t-tests between Pretest and Posttest Data for the Experimental Group

Variable	Means Pre	Post	*t*	*p*
Computer Vocabulary	1.96	5.12	8.48	<.001
Computer-Using Skill	2.44	4.88	8.61	<.001
Keyboard Skills	6.80	15.80	8.90	<.001

n = 25

Table 5 shows the results of correlated *t*-tests performed on the means from the pretests and posttests carried out on the Control Group. These results indicated significant mean differences between the pretest and posttest scores for Computer Vocabulary, for Computer-Using Skills, and for Keyboard Skills. These significant differences can be attributed to the facts that the students had already completed the tests once (as pretests) and that they were three months older and had that much more opportunity for learning about computers outside of the classroom.

Although the pretest and posttest means for the three tests were shown to be significantly different within the Control Group, the posttest mean scores from the Experimental Group were significantly higher when compared with the posttest mean scores from the Control Group. This was demonstrated by testing Hypotheses 1 and 2. Graphs showing these significant positive changes in the posttest means from the Experimental Group as compared to the Control Group for Computer Vocabulary and Computer-Using Skills are in Figures 1 and 2 respectively. These graphs also show the improvement on the posttest mean scores for Computer Vocabulary and Computer-Using Skills when compared to the mean pretest scores for the Experimental and Control Groups. Therefore, it was demonstrated that Computer Vocabulary and Computer-Using Skills as measured by the instruments in this study, can be improved by the daily use of computers in the classroom.

TABLE 5

Correlated t-tests between Pretest and Posttest Data for the Control Group

Variable	Means Pre	Post	*t*	*p*
Computer Vocabulary	1.35	2.69	5.07	<.001
Computer-Using Skill	1.96	2.73	2.87	<.01
Keyboard Skills	7.39	11.15	5.22	<.001

n = 26

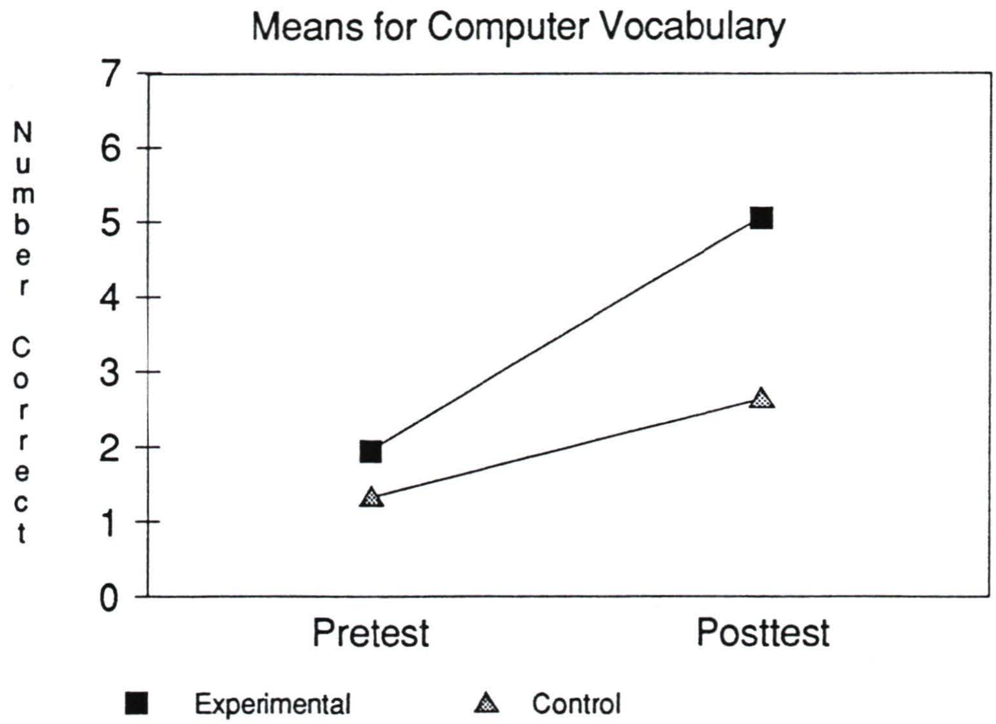

Figure 1. Computer Vocabulary Pretest and Posttest Means for the Experimental and Control Groups.

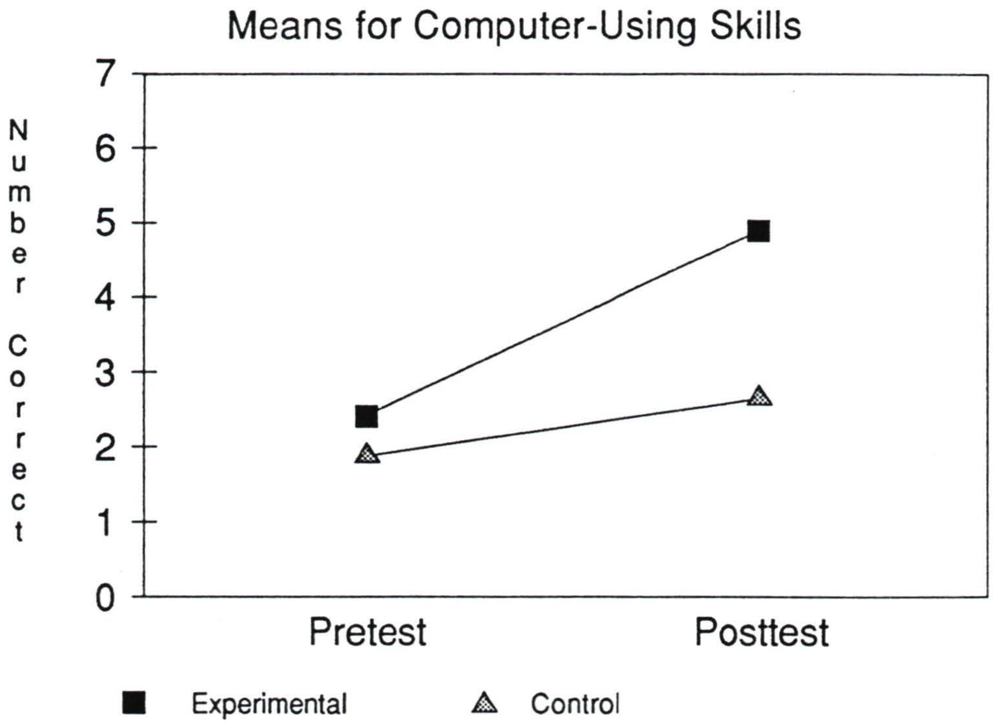

Figure 2. Computer-Using Skills Pretest and Posttest Means for Experimental and Control Groups.

Research Question Three

Do children at the first grade level have the fine psychomotor development necessary to acquire keyboarding skills?

Hypothesis 5

Ho:5 There will be no significant mean difference on the Keyboard Skill posttest between the Experimental and Control Groups.

As was shown by the data in Table 1, there was no significant difference in the mean pretest Keyboard Skill scores from the Experimental and Control Groups, $t(49) = .52$, p = n.s. This was necessary to establish before posttest results could be compared.

A *t*-test was carried out on the posttest Keyboard Skill mean scores between the Experimental and Control Groups. As shown in Table 3, the null hypothesis was rejected, $t(49) = 4.57$, $p < .001$. The Experimental Group showed a significantly greater ability to input the correct letter than did the Control Group.

Hypothesis 6

Ho:6 There will be no significant mean difference on pretest and posttest Keyboard Skill scores within the Experimental Group.

A correlated *t*-test was carried out on the pretest and posttest results from the Experimental Group to test this hypothesis. This analysis, as shown in Table 4, indicated rejection of the null hypothesis as the difference was significant, $t(48) = 8.9$, $p < .001$. The Experimental Group showed significant positive improvement between the time of the pretesting and the time of the posttesting.

The pretest and posttest means for the Experimental and Control Groups are shown in Figure 3. The graph is indicative of a significant positive change in the posttest mean score for keyboarding skills from the Experimental Group when compared with the posttest mean score from the Control Group. The graph also shows a significant improvement in the mean posttest scores when compared to the mean pretest scores in both the Experimental and the Control Groups.

The results from testing Hypotheses 5 and 6 indicated that using a micro-computer over a period of time can improve a child's keyboarding skills at the first grade level. This is important as the fine motor skill abilities at this grade-level have not been thoroughly researched and the results from this analysis should contribute information supporting the fact that young students can significantly improve these skills.

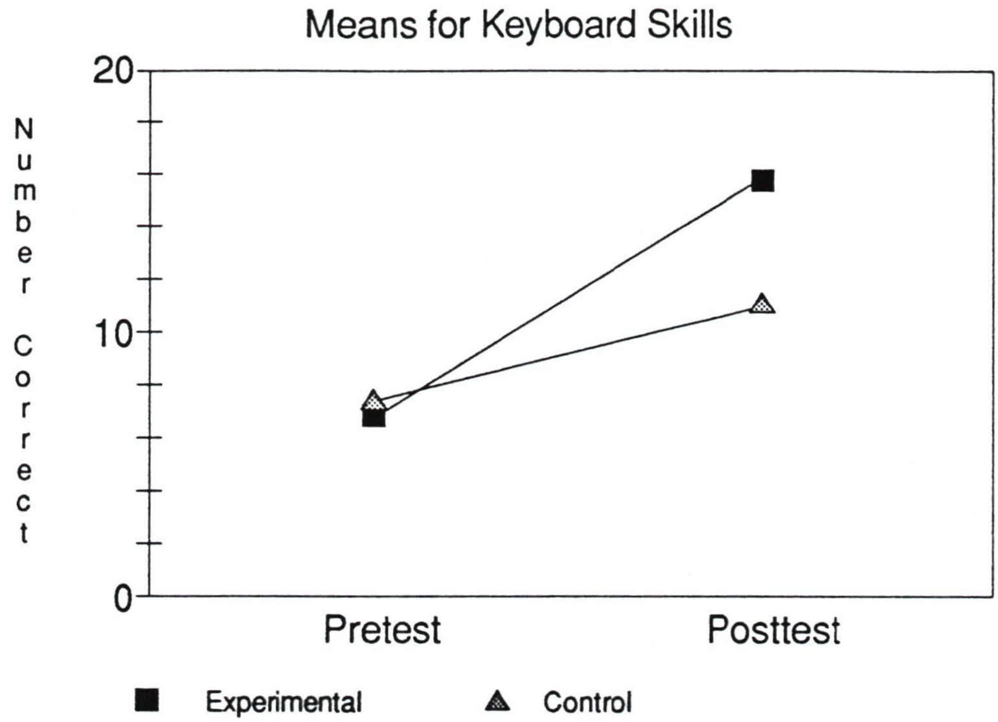

Figure 3. Keyboard Skill Pretest and Posttest Means for the Experimental and Control Groups.

Research Question Four

Is the gender of the child related to his or her ability to acquire keyboarding skills?

Hypothesis 7

Ho:7 There will be no significant mean difference on posttest Keyboard Skill scores between males and females in the Experimental Group.

In order to test this hypothesis, it was first established that there was no significant difference on the mean pretest Keyboard Skill scores between the males and females in the Experimental Group. A *t*-test was carried out on the pretest data the results of which are shown in Table 6. They indicate that the difference between the males' and females' mean keyboard skill abilities was not significant, $t(25) = 1.48$, p = n.s.

A *t*-test was then carried out to determine if the mean difference on the Keyboard Skills posttest between males and females was significant. The result of this test, shown in Table 6, indicated the null hypothesis could not be rejected, $t(25) = .65$, p = n.s. No connection between the gender of the child and the child's ability to improve his or her keyboard skills with daily keyboard practise could be determined.

TABLE 6

T-tests comparing Males and Females from the Experimental Group on Keyboard Skills

	Males		Females			
Tests	*M*	*SD*	*M*	*SD*	*t*	*p*
	n=13		*n*=12			
Pre	5.62	4.50	8.08	3.83	1.48	n.s.
Post	15.39	2.96	16.25	3.65	.65	n.s.

Total Possible Score = 20

Although not statistically significant, the mean percentage correct for females was higher than that for the males. This was true for the pretest results, as well as for the posttest results from both the Experimental and Control Groups. These results are shown in Tables 7 through 9. In the Experimental Group, however, the males did improve more in the posttest scores than did the females (see Table 6), although again the results were not statistically significant. Further study is needed in order to establish if these trends of differences between males and females in keyboard skill abilities can be replicated in a larger sample.

The number of responses of the specific alphabetical characters which were input correctly was also determined (see Tables 7 through 9). An examination of the correct responses for the three sets of data (pretest scores for the two groups combined and posttest scores for the two groups separately) indicated some consistency. For example, the letters "X" and "S" were the only letters that occurred in all three sets of data in the highest three frequencies of correctly input answers. The letter "Q" was the only letter that occurred consistently in the two lowest frequencies of correctly input responses in the three data sets.

TABLE 7

Frequency of Correct Responses on Pretests for Males and Females from the Experimental and Control Groups

Character	Percent Correct Male n = 26	Percent Correct Female n = 25	Total Percent Correct n = 51
A	38.46	52.00	45.10
B	11.54	28.00	19.61
C	23.08	68.00	45.10
D	42.31	48.00	45.10
E	23.08	16.00	19.61
F	30.77	32.00	31.37
G	38.46	56.00	47.06
H	30.77	20.00	25.49
J	38.46	52.00	45.10
K	30.77	28.00	29.41
M	26.92	36.00	31.37
N	30.77	40.00	35.29
P	38.46	32.00	35.29
Q	11.54	20.00	15.69
S	73.08	68.00	70.59
T	23.08	20.00	21.57
W	26.92	4.00	15.69
X	57.69	88.00	72.55
Y	7.69	20.00	13.73
Z	38.46	52.00	45.10

Mean Male Percentage Correct = 32.10
Mean Female Percentage Correct = 39.05
Mean Total Percentage Correct = 35.45

TABLE 8

Frequency of Correct Responses for Males and Females on Posttests from the Experimental Group

Character	Percent Correct Male n = 13	Percent Correct Female n = 12	Total Percent Correct n = 25
A	84.62	91.66	88.00
B	84.62	66.67	76.00
C	76.92	83.33	80.00
D	69.23	75.00	72.00
E	84.62	75.00	80.00
F	61.54	75.00	64.00
G	84.62	91.66	88.00
H	76.92	83.33	80.00
J	53.85	66.67	60.00
K	61.54	100.00	80.00
M	76.92	91.66	84.00
N	76.92	91.66	84.00
P	84.62	91.66	88.00
Q	53.85	33.33	44.00
S	84.62	100.00	92.00
T	100.00	83.33	92.00
W	69.23	75.00	72.00
X	84.62	100.00	92.00
Y	100.00	75.00	88.00
Z	69.23	75.00	72.00

Mean Male Percentage Correct = 76.95

Mean Female Percentage Correct = 81.25

Mean Total Percentage Correct = 79.00

TABLE 9

Frequency of Correct Responses for Males and Females on Posttests from the Control Group

Character	Percent Correct Male $n = 13$	Percent Correct Female $n = 13$	Total Percent Correct $n = 26$
A	76.92	61.54	69.23
B	30.77	30.77	30.77
C	69.23	38.46	53.85
D	84.62	76.92	80.77
E	30.77	76.92	53.85
F	53.85	53.85	53.85
G	76.92	76.92	76.92
H	38.46	30.77	34.62
J	69.23	61.54	65.39
K	38.46	46.15	42.31
M	61.54	84.62	73.08
N	38.46	53.85	46.15
P	46.15	84.62	65.39
Q	23.08	38.46	30.77
S	61.54	84.62	73.08
T	46.15	76.92	61.54
W	15.39	30.77	23.08
X	61.54	92.31	76.92
Y	30.77	30.77	30.77
Z	69.23	76.92	73.08

Mean Male Percentage Correct = 51.15
Mean Female Percentage Correct = 60.40
Mean Total Percentage Correct = 55.75

There could be a number of reasons for the letters to be consistently input correctly. For example, in this test, three letters were displayed at the beginning of the test in order to demonstrate to the child how the program worked. Two of these letters were "X" and "S", both which appeared within the highest frequencies of correctly input responses (see Tables 7 through 9). The third letter, "P" did not. This practice session probably influenced the results, and different letters could possibly appear with higher frequencies under different testing conditions.

A possible reason for a consistently low correct response rate could be the placement on the keyboard of the specific letter. For example, the letter "Q" was consistently input incorrectly and is also located in the upper-most left-hand position of the keyboard. If the individual responding in the test is not familiar with the layout of a keyboard, it may take a longer period of time to locate "Q" and type it correctly than a letter that is located in the central area of the keyboard.

Another reason for consistencies in the correct response rate is the familiarity with the specific letters that the individual being tested has. Young children will be most familiar with the positions of letters they frequently use. The letter "Q" is not an often-used letter and therefore children would probably not remember where it is located.

CHAPTER 6

Conclusions and Implications

Conclusions

The results from the interviews and the six pretests indicated that the average child tested in this sample had little or no computer expertise at the time of the pretesting. Furthermore, the average child did not have a computer at home, nor had there been one available in his or her kindergarten classroom. However, a fairly large percentage of the children tested (51%) had used a computer in some capacity at least once. Most of the children could correctly identify a microcomputer system and indicate where and for what functions a computer could be used. However, the means from the Computer Vocabulary, Computer-Using Skills, and Keyboard Skill tests were all low (below 36%), and indicated that the children were not able to name the hardware parts, use a computer independently, nor input on the keyboard accurately.

The statistical results from the observational posttests showed that there were significant differences between the Experimental and Control Groups in computer vocabulary and computer-using skills. The Experimental Group had a significantly higher posttest mean in both these tests. Analyses of the Computer Vocabulary and Computer-Using pretest and posttest results from the Experimental Group, also indicated significantly higher posttest means. This information indicated that the use of computers for about three months as learning tools in the classroom significantly improved first grade children's computer vocabulary and computer-using skills.

The analysis carried out on the data from the Keyboard Skill test again indicated a significant difference between the posttest results from the Experimental and Control Groups. The mean score recorded from the Experimental Group was significantly higher than the mean score from the Control Group. Similarly, the results from the Keyboard Skill pretests and posttests for the Experimental Group indicated a significantly higher posttest mean score. It was apparent from these results that daily use of a keyboard over the period of approximately three months significantly improved the fine psychomotor skills involved in keyboarding abilities at the first grade level.

Significant differences in the three tests, Computer Vocabulary, Computer-Using Skills and Keyboard Skills, between the pre- and posttest mean scores from the Control Group were also observed. These significant differences could be caused by the facts that the students had completed the posttests previously (as pretests) and that they were three months older and during that time had opportunities for computer exposure outside of the classroom. However, even though these differences were significant, the posttest mean scores from the Experimental Group were still significantly higher than the posttest mean scores from the Control Group.

There could be no conclusions drawn regarding the relationship between the gender of the child and his or her ability to acquire keyboarding skills. The mean difference on the Keyboard Skill test between males and females was not significant.

The letters "X" and "S" were consistently input accurately in the Keyboard Skill test in the pre-data and post-data sets. To software developers this could be a meaningful place to begin research about the letters that should be used in software applications or in CAI for young children.

In conclusion, introducing computer-related activities is practical and reasonable at the primary grade level. The children in the Experimental Group showed significant improvement in their abilities to name computer parts, to use the computer, and to input accurately on the keyboard, thus indicating that first grade children can successfully learn to use computers as educational tools.

Implications for Future Research

One method of instructing about computers was examined in this study. That method was to have children use computers in the classroom as learning tools for a task unrelated to computer literacy, in this case learning to write and read. Future research could look at other methods of teaching computer usage and skills, and their successfulness when measured by specific measuring techniques.

Further research could enhance the measurement procedures used in this study to examine more closely one or more aspects of the computer skills tested. For example, a more extensive set of tests could be developed to measure the speed and accuracy of keyboard responses. These tests could include repetition of some characters or the display of randomly generated characters. Tests such as these would provide more evidence about the letters most and least frequently input correctly.

The measuring techniques developed for this study could be improved by further analysis of the instruments, the children's responses and the data produced. Other methods of assessing the computer skills and knowledge that children have acquired prior to starting school could be utilized.

Although gender differences in the students' abilities to improve their keyboard skills were present in this study, they were not statistically significant. More research is needed to determine if there exists a relationship between the children's gender and their abilities to acquire keyboarding skills.

Studies in computer usage and knowledge should also be expanded to include students of other age-levels, and students that represent other samples in the general population, such as minority groups. These would provide evidence for the support of the conclusions drawn from this study, and help determine if they are applicable in other situations.

References

Beeson, B. S., & Williams, R. A. (1985). The effects of gender and age on preschool children's choice of the computer as a child-selected activity. *Journal of the American Society for Information Science.* September, 339-341.

Brady, H. (1984). Who needs ten-finger typing. *Classroom Computer Learning, 5,* 64-69.

Davis, B.J., & Little, M. (1984). Keyboarding for computer efficiency in a gifted/talented program. *Journal of Business Education, 60,* 104-107.

Educational Testing Service. (1984). *The ETS evaluation of Writing to Read.* Princeton, New Jersey.

Gledhill, V. X. (1985). Computer-assisted instruction: Some issues. *Search, 16,* 89-94.

Goodwin, W. L., & Driscoll, L. A. (1980). *Handbook for measurement and evaluation in early childhood education.* San Francisco, CA.: Jossey-Bass Publishers.

Hawkins, P. (1982). Kids hands prove to be the entry point to learning. *IPD News, 1,* 12-17.

Howlett, K. (1986, November). Can our kids hack it with computers? *Report on Business Management,* pp. 85-91.

Johnson, J. E. (1985). Characteristics of preschoolers interested in microcomputers. *Journal of Educational Research, 78,* 299-305.

Junyk, M. (1986). Computers in kindergarten. *Computers in Education,* January, 8-9.

Keller, J., & Shanahan, D. (1983). Robots in the kindergarten. *The Computing Teacher, 10*(9), 66-67.

Long, S. M. (1982). The dawning of the computer age: An interview with Ronald Palamara. *Phi Delta Kappan, 63,* 311-313.

Maddux, C.D. (1984). Educational microcomputing: The need for research. *Computers in the Schools, 1,* 35-41.

Mander, C. (1982). An Oakville enterprise: Computers teach preschoolers to read and write. *Canadian Library Journal, 39,* 17-18.

Maynard, R. (1986, September). High-tech schooling. *Homemaker's*, pp. 13-26.

Naymark, J., & Plaisant, C. (1986). The computer and the pre-school child; The written language and play. *Computer Education, 10,* 167-174.

Nieboer, R. A. (1983). *A study of the effect of computers in the preschool environment.* Master's thesis, Oakland University.

Papert, S. (1982). Let's forget about drill and practice ... computers are objects to think with. *Instructor, 7,* 86-89.

Phillips, R. C. (1968). *Evaluation in Education.* Columbus, OH.: Charles E. Merrill Publishing Company.

Piazza, C.L. & Riggs, S. (1984). Writing with a computer: An invitation to play. *Early Childhood Development and Care, 17*, 63-76.

Piestrup, A. M. (1981). *Preschool children use AppleII to test reading skills programs.* (ERIC Document Reproduction Service No. ED 202 476.)

Shrock, S. A., (1985, January). *Examining the effects of the microcomputer on a real world class: A naturalistic study.* Paper presented at the Annual Convention of the Association for Educational Communications and Technology, Anaheim, CA.

Sprigle, J. E. & Schaefer, L. (1984). Age, gender, and spatial knowledge influences on preschoolers' computer programming ability. *Early Child Development and Care, 14,* 243-250.

Taylor, H. L. S. (1983). *Microcomputers in the early childhood classroom.* Edmonds Community College, Lynwood, Wash.

TenBrink, T. D. (1974). *Evaluation: A practical guide for teachers.* New York: McGraw-Hill.

Ungerleider, C. (1983). Teaching, technology and literacy. *BC Teacher, 63,* 36.

Walker, D. K. (1973). *Socioemotional measures for preschool and kindergarten children.*, San Francisco, CA.: Jossey-Bass Publishers.

Watt, D. (1983). Is computer education out of control? *Popular Computing, 2,* 83-83.

Wilder, G., Mackie, D., & Cooper, J. (1985). Gender and computers: Two surveys of computer-related attitudes. *Sex Roles, 13,* 215-223.

Woodill, G., Anderson, K., & Bernhard, J. (1985). *Sexism, computers and young children.* Paper presented at the AEDS conference in Toronto, Canada.

'Writing to Read' - Challenging an age-old tradition. (1984). *Electronic Education, 3,* 21-22.

Zigich, M. (1982). *A new computer! Can I use it?* Unpublished manuscript. Nova University.

APPENDIX A

Interview Questions

Interview to establish child's computer background. Questions to be asked:

1. Do you have a computer in your home?

2. Do you have computers in your school?

3. Do you have a computer in your classroom?

4. Do any of your friends have computers in their homes?

5. Do either of your parents use computers at work?

6. Do your brothers or sisters use computers at school?

7. Have you ever seen a computer before?

   - at home
   - at school
   - in a store
   - on television
   - in a friend's home
   - at parent's work

8. Have you ever used a computer before?

   - at home
   - at school
   - in a store

- in a friend's home

9. If yes, what did you do on the computer?

    - played games

    - other

10. Do you have a typewriter in your classroom?

    - If yes, have you used it?

APPENDIX B

Objective Tests

Computer Identification. There were twenty-two cards present with pictures of various machines on them, including computers and peripherals. The student was given the cards in a pre-set order and asked to give the names of each.

Computer Recognition. The same twenty-two cards were given to the student and they were orally given names of various machines and asked to remove the card or cards which corresponded to the names. There were some names given for which there is not a picture, and some duplicate pictures of one name. Some of the pictures could be used for more than one name. The following is a list of names. The numbers in brackets indicate the number of cards correrspondlng to the name.

1. power saw (1)
2. table-top oven (1)
3. tape player (1)
4. egg beater (0)
5. camera (1)
6. computer (5)

7. vacuum cleaner (1)

8. telephone (1)

9. air freshner (1)

10. radio (2)

11. printer (2)

12. toaster (0)

13. joystick (1)

14. router (1)

15. coffee maker (1)

Computer Usage. The same pictures were present and the students were orally asked to choose a picture or pictures for various functions. There may be no suitable picture present and this was explained. The following is a list of the functions. The numbers in brackets indicate the number of cards corresponding to the functions.

1. when house cleaning (1)

2. to take pictures (1)

3. when making furniture (1)

4. to play tapes on (1)

5. to practise reading and spelling (6) - includes typewriter

6. to cut grass (0)

7. to type a letter on (1)

8. to talk to friends on (1)

9. to play games on (3) - only micros with screens

10. to make coffee (1)

Computer Functions. The student was asked if a computer could be used for the following functions.

1. to wash dishes.

2. to drive a car.

3. to play a game.

4. to garden.

5. to cut down trees.

6. to help write a story.

7. to draw on the blackboard.

8. to make cookies.

9. to help with school work.

10. to buy clothes.

APPENDIX C

Observational Measurements

Computer Vocabulary. The student was asked to point out the following:

1. disk drive
2. monitor (screen)
3. keyboard
4. on/off switch
5. return key
6. space bar
7. on/off monitor switch
8. control key
9. disk

Computer-Using Skill. The student was given a diskette and asked to start up the machine. The following steps that were followed in the required order was recorded:

1. remove disk from sleeve
2. correct place for disk to be inserted

3. correct method of disk insertion

4. "door" of disk drive closed

5. now main switch

6. switch on

7. monitor on

APPENDIX D

Computer Program to Record Keyboard Skills

```
5 REM PROGRAM TO TEST KEY-BOARD SKILLS
9 REM SET DISPLAY MODE AT 2X NORMAL SIZE
10 SCREEN 1
19 REM INITIALIZE ARRAYS
20 DIM A(20),X$(20),Y$(20),Z$(20),T(20)
29 REM LOAD ARRAY WITH CHARACTERS
30 X = 65
40 FOR I = 1 TO 20
50 A(I) = X
55 IF A(I) = 86 THEN A(I) = 88
60 X = X + 3
70 IF X > 90 THEN X = X - 26
80 NEXT I
89 REM INPUT "M" (MALE) OR "F" (FEMALE) BEFORE NAME
90 INPUT "IDENTIFICATION (00 TO END)";A$
100 IF A$ = "00" GOTO 600
110 FOR I = 6 TO 8
120 CLS
130 FOR J = 1 TO 10
140 PRINT
150 NEXT J
159 REM DISPLAY 3 PRACTISE LETTERS
160 PRINT TAB(17) CHR$(A(I))
170 B$ = INKEY$
180 IF B$ = "" GOTO 170
```

```
190 NEXT I
200 CLS
209 REM TO CONTINUE TYPE "Y"
210 INPUT "READY? (Y OR N) ";C$
220 IF C$ <> "Y" AND C$ <> "y" GOTO 90
229 REM INITIALIZE COUNTERS - TT IS TOTAL TIME, TC IS TOTAL CORRECT
230 TT = 0:TC = 0
239 REM LOOP FOR DISPLAYING CHARACTERS
240 FOR I = 1 TO 20
250 CLS
259 REM LOOP FOR BLANK LINES
260 FOR J = 1 TO 10
270 PRINT
280 NEXT J
289 REM DISPLAY CHARACTERS
290 PRINT TAB(17) CHR$(A(I))
300 J = 1
309 REM CHECK IS TIME HAS ELAPSED - DISPLAY NEXT CHARACTER
310 IF J = 500 GOTO 410
320 J = J + 1
329 REM CHECK FOR RESPONSE
330 B$ = INKEY$: IF B$ = "" GOTO 310
339 REM CHECK IF CORRECT RESPONSE
340 IF B$ = CHR$(A(I)) GOTO 370
349 REM IF INCORRECT RESPONSE
350 X$(I)=B$:Y$(I)=CHR$(A(I)):Z$(I)="INCORRECT RESPONSE":T(I)=J
360 GOTO 420
369 REM IF CORRECT RESPONSE
370 X$(I)=B$:Y$(I)=CHR$(A(I)):Z$(I)="CORRECT RESPONSE":T(I)=J
```

```
379 REM INCREASE TIME
380 TT = TT + J
389 REM INCREMENT TOTAL CORRECT
390 TC = TC + 1
400 GOTO 420
409 REM IF NO RESPONSE
410 X$(I)=B$:Y$(I)=CHR$(A(I)):Z$(I)="NO RESPONSE":T(I)=J
420 NEXT I
429 REM OPEN OUTPUT FILE AND DATA TO IT
430 OPEN "OUTFILE" FOR APPEND AS #1
440 PRINT #1, "ID IS ";A$
450 PRINT #1, "ANSWER    CHARACTER       TIME        MESSAGE"
460 FOR I = 1 TO 20
470 PRINT #1, X$(I), Y$(I), T(I), Z$(I)
480 NEXT I
490 PRINT #1, "TOTAL CORRECT IS ";TC
499 REM AVTI IS AVERAGE TIME FOR CORRECT RESPONSE
500 AVTI = TT/TC
510 PRINT #1, "TOTAL TIME FOR CORRECT RESPONSES ";TT
520 PRINT #1, "AVERAGE TIME FOR CORRECT RESPONSE ";AVTI
529 REM LOOP FOR BLANK LINES
530 FOR I = 1 TO 3
540 PRINT #1, ""
550 NEXT I
560 CLOSE
600 END
```

APPENDIX E

Identification and Order of Cards Used

1. vacuum cleaner
2. stereo tape player
3. air filter system
4. printer
5. camera
6. microcomputer system
7. toaster oven
8. microcomputer system - IBM
9. radio/telephone
10. electric typewriter
11. calculator
12. microcomputer system - Visual
13. sewing machine
14. T.V.
15. printer

16. coffee maker

17. joystick

18. microcomputer system - Compaq

19. router

20. power saw

21. microprocessor - Commodore 64

22. T.V.

APPENDIX F

Pilot Study

The interview, the four objective tests, the observational measurements and the keyboard skill test were administered to four kindergarten-aged children as a pilot test. This pilot was carried out to determine if the measuring instruments were appropriate, and to get initial support for their reliability and validity for measuring computer knowledge and skills in young children.

Two of these children had some experience using microcomputers. They both lived in homes which had computers and both had parents that encouraged the children to use the computers for playing simple educational games. The other two children had never, to the best of their parents' knowledge, used a microcomputer. As a result of this pilot, a number of minor changes were made to the measuring instruments.

The first change was that there were questions added to the interview as some common possibilities had not originally been included. For example, there had not been a question regarding computer use in kindergarten classes in the initial interview.

A second change was that originally, there were twenty-six cards with pictures of machines laminated onto them used for three of the objective tests, but four of these cards were removed as a result of the pilot. Three of the four that were removed were pictures of microcomputer systems, all very similar to each other and similar to others that remained. The fourth was a picture of a video-cassette recorder which confused all four children.

A third change was that the computer program to measure keyboard skills was adjusted to allow more time for the responses. Initially, approximately three seconds were allowed before another letter was displayed on the screen, but the first child in the pilot to try the program could not type any correct responses within this time so the time allowed was increased. Another change was that the letter "V" was removed from the program as one of the letters displayed, as all the children asked whether it was a "U" or a "V".

The interview section verified that the children's experiences, or lack of, with microcomputers were the same as their parents had stated they were.

The consistency of the measuring instruments was substantiated by the fact that the two children who were experienced with computers received higher scores than the other two on the tests developed to measure computer recognition, usage, functions, vocabulary, and using skills. However, only one of the children experienced with computers received a higher score than the other three on the test developed to record keyboarding skills. This could have been due to previous typewriter usage by the children without computer experience.

VITA

Surname: Phillips Given Names: Susan Elizabeth

Place of Birth: New Westminister, British Columbia

Date of Birth: September 29, 1950

Educational Institutes Attended, with Dates of Entering and Leaving:

University of British Columbia 1968 - 1973

Camosun College 1981 - 1983

University of Victoria 1983 - 1986

Degrees, Diplomas, Etc., Awarded with Dates and Names of Institutions:

B.H.E. 1972 University of British Columbia

Diploma of Computer Technology 1983 Camosun College

Honors and Awards:

Publications:

PARTIAL COPYRIGHT LICENSE

Title of Thesis/Dissertation

COMPUTER READINESS IN GRADE ONE

Author [redacted]

Signature

Susan E. Phillips

Name

December 15, 1986

Date